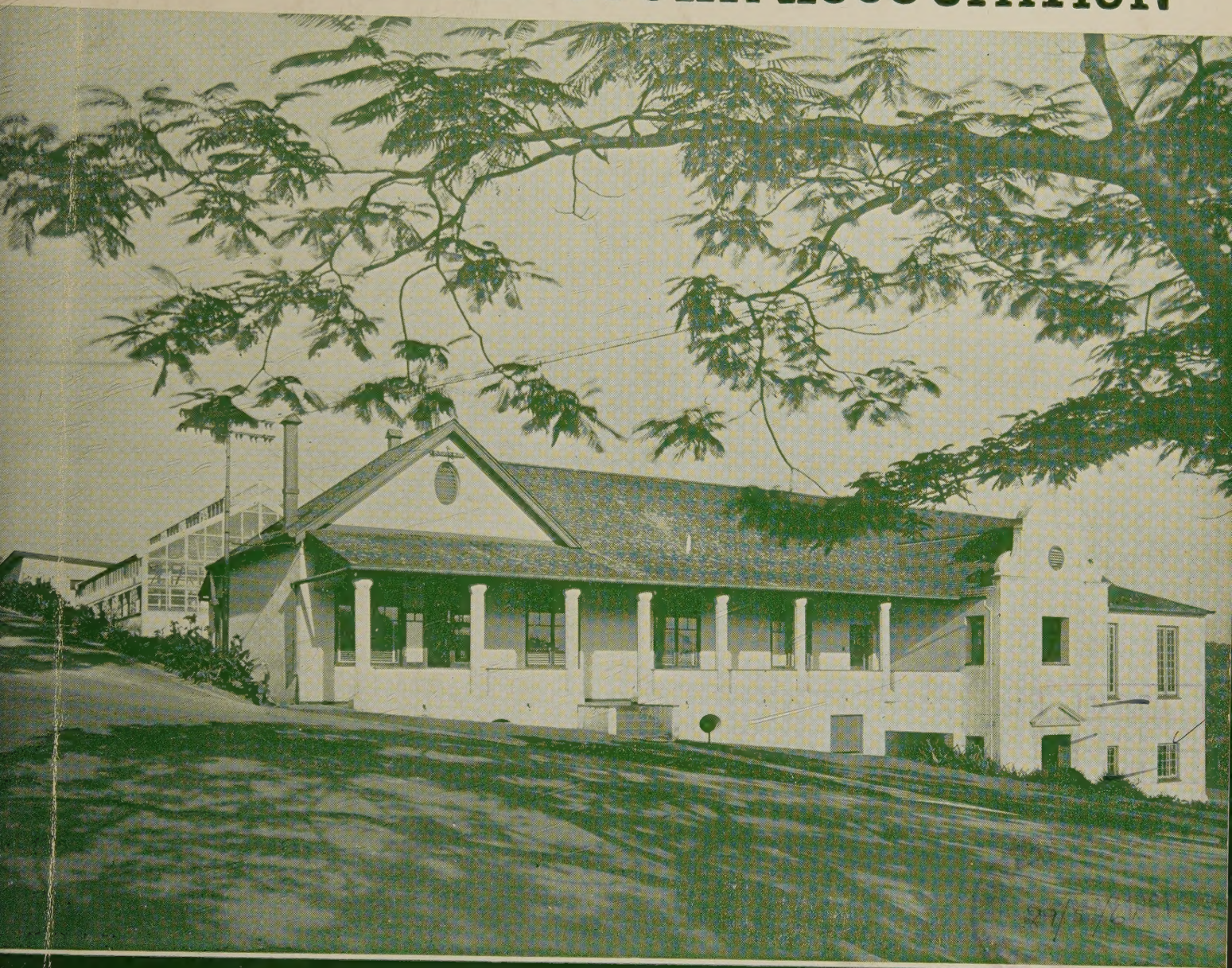
Experiment Station

OF THE

SOUTH AFRICAN SUGAR ASSOCIATION



Annual Report 1959-60

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SOUTH AFRICAN SUGAR ASSOCIATION

EXPERIMENT STATION

MOUNT EDGECOMBE

NATAL

REPORT

for

1959 - 1960

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The Experiment Station

The Experiment Station of the South African Sugar Association is financed wholly from funds contributed by the Sugar Industry, the South African Cane Growers' Association and the Natal Sugar Millers' Association sharing the cost of maintenance and development.

The main station at Mount Edgecombe, first established in 1925 and consisting of 116 acres held on long lease from The Natal Estates Ltd., now serves as the headquarters of the administrative, research, advisory, and extension services and is also the main centre for sugarcane breeding. Field facilities have been extended from time to time to meet the increasing demands of an expanding experimental programme.

Thus in 1946, 200 acres were acquired on long lease near Chaka's Kraal, some 25 miles further north of Mount Edgecombe. They have been developed with irrigation facilities for a wide range of field trials.

A further 300 acres were purchased outright in 1955 near Mtunzini in Zululand and this area is now being developed as an additional field trial and seed propagation station.

The Experiment Station also incorporates a Fertilizer Advisory Laboratory which provides a free advisory service to all sections of the Industry.

An extensive reference library covering all aspects of sugar production and the sciences relevant thereto is maintained at the Experiment Station. The library, and the various services it provides, is open to all members of the Industry and to approved institutions and organizations outside of the Industry proper.

Functions of the Experiment Station

The principal functions of the Station are as follows :—

1. The development of new varieties of sugarcane both by breeding and by introduction and the propagation and distribution of selected varieties to meet the diverse needs of the Industry.
2. The investigation of agronomic problems of sugarcane production.
3. The studies of the soils of the sugarcane producing areas.
4. The study of the nutritional requirements of sugarcane.
5. The study of pests and diseases of sugarcane and the development of appropriate control measures.
6. Other investigations on such problems as arise from time to time.
7. The dissemination of information relating to sugarcane production.
8. The issuing of advice on fertilizer usage, disease and pest control and other aspects of crop management.
9. The exchange of information and material, and collaboration with other research institutions in South Africa and other countries.

MANAGEMENT COMMITTEE OF THE EXPERIMENT STATION
1959-1960

Nominated by the Natal Sugar Millers' Association

O. W. M. PEARCE *(Chairman)*	
H. L. GARLAND	
F. S. V. GILLATT	alternate G. PEDDIE
J. N. HULETT	,, W. K. BUCHANAN
C. F. POLLOCK	,, W. WYATT

Nominated by the South African Cane Growers' Association

W. J. G. BARNES *(Vice Chairman)*	
D. W. LONDON	alternate G. C. FLEWELLEN
B. S. MORRIS	,, W. HIRST SIMPSON
W. T. ROBBINS	
I. G. B SMEATON	

EXECUTIVE COMMITTEE

Members : O. W. M. PEARCE *(Chairman)*
W. J. G. BARNES *(Vice Chairman)*
H. L. GARLAND
F. S. V. GILLATT
D. W. LONDON

Co-opted from Experiment Station Staff :

J. WILSON *(Director)*
L. B. WEBER *(Secretary)*

THE EXPERIMENT STATION

MOUNT EDGECOMBE

Incorporating

THE EXPERIMENTAL FARM, CHAKA'S KRAAL, NORTH COAST, NATAL.

THE PROPAGATION FARM, MTUNZINI, ZULULAND, NATAL.

THE FERTILIZER ADVISORY LABORATORY, REDHILL, DURBAN.

List of Staff.

APRIL, 1960.

Director :
J. WILSON, B.Sc. Hons. (Dunelm)

Secretary :
L. B. WEBER, F.C.C.S.

Agriculture

Chief Agricultural Officer: C. H. O. PEARSON, B.A. (Oxon), B.A. (Cantab.)

Assistant Staff: L. ALLSOPP, L. H. GORVETT.

Farm Managers :
Experiment Station: F. L. ALMOND.
Experimental Farm: C. E. BOOTH.
Propagation Farm: R. B. COX.

Chemistry

Chief Research Chemist: J. L. DU TOIT, M.Sc. (Stellen.)

Scientific Staff: K. E. F. ALEXANDER.

Assistant Staff: Mrs. M. WELLS.

Soils

Soil Scientist: B. E. BEATER, B.A., D.Sc. (Agric.), F.R.I.C., F.R.S. (S.A.)

Pedologist: R. R. MAUD, B.Sc. Hons. (Natal).

Assistant Staff: Miss H. BLEVINS.

Botany and Plant Breeding

Plant Breeder: P. G. C. BRETT, M.Sc. (S.A.), Ph.D. (Natal).

Scientific Staff : T. B. BRASSEY, B.A. (Oxon.)

Plant Pathology

Plant Pathologist: G. M. THOMSON, M.Sc. (Natal).

Microbiologist : J. R. ANDERSON, B.Sc. Agric. (Natal).

Disease Inspector: H. V. FRANCES.

Entomology

Entomologist: J. DICK, M.Sc. (S.A.), Ph.D. (London), D.I.C.

Biometry

Statistician: Mrs. B. DICK (temporary appt.)

Extension Services

Regional Representatives:
J. M. ROBERTSON, B.Sc. Agric. (Edin.)
D. P. UPTON.
D. A. ROUTLEDGE, B.Sc. Agric. (Natal).
J. J. WARD, B.Sc. Agric. (Natal).

Fertilizer Advisory Service

Chemist: T. A. F. SEXTON, B.Sc. Hons. (London), F.R.I.C.

Assistant Staff: R. A. G. RAWSON.

Library

Librarian: Mrs. M. M. BARNES.

Administration

Secretary: L. B. WEBER, F.C.C.S.

Assistant Staff:
Experiment Station:
Mrs. M. L. SARGENT, Miss W. N. TEALE.
Mrs. N. CLIFTON, Mrs. M. TREACY.
Fertilizer Advisory Laboratory:
Mrs. G. BOWKER, Mrs. N. VAN DER MERWE.

Maintenance Services

Building Supervisor: H. G. MUNRO.

Transport Foreman : A. E. LANG.

Senior Indian Assistant

V. CHELLAN.

Senior African Assistant

NDABAZEZWE NDHLOVU.

Staff resignations during the year

Miss I. M. GRAVETT — Statistician
A. H. HICKS — Agricultural Assistant

General Report

The period under review may perhaps best be regarded as a transitional phase in the development of the Experiment Station, for the year has not only seen the appointment of a new Director but has also brought a rapid and dramatic change in the production position in the Industry.

Since 1948 when the call for increased production was made the response has been such that by 1958 there were already signs that a halt must soon be called if an embarrassing surplus of sugar was not to accumulate. As was to be expected of a research institution which is so closely associated with the Industry it serves, much of the efforts of the research staff during this period had been concentrated on investigating ways and means of increasing crop yields by the use of fertilizers, disease and pest control, new varieties and the like. Because of the wide variation in environments encountered in the Natal sugar belt and more particularly that of soils, it was inevitable that the field experimental programme had to be expanded far beyond the bounds of the Experiment Station and its subsidiary farms, so as to obtain the range of information necessary on fertilizer rates and the yielding ability and disease resistance of different varieties to form the basis of sound advice for issue to planters. With a limited staff, preoccupation with this extensive programme precluded the possibility of paying all but the most superficial attention to many other important aspects of sugarcane husbandry, which in the circumstances were justifiably accorded low priority in the programme of work.

A considerable part of the expanded production was brought about by an extension of acreage under cane, not only in the form of new farms but also on existing farms where land previously considered as unsuited for cane was brought into production. These latter areas raised many problems some of which seem likely to remain, so long as the grower persists in continuing to produce cane on them.

Nevertheless answers to many diverse problems were found during this period and have now been incorporated into standard field practice by many growers.

With no limits to production and land available for expansion, maintenance of existing profit margins was sufficient to ensure a rising income for the grower who increased his production. With restrictions imposed on production, however, a very different picture is now presented, and the grower who hopes to increase his income from sugarcane must look to his efficiency as measured by his costs of production, and seek ways and means of reducing them if he is to achieve his aim. At the same time he must not so cut his costs that he fails to achieve as a result of his action the full extent of his permissable quota in both the current and subsequent crops.

In the changed circumstances therefore, it now becomes even more imperative than ever before to consider the economic implications of each and every farm operation, as well as their effect on final yield. Any luxury operation must be ruthlessly excluded whether it be the extra harrowing, the extra six or eight inches depth of furrow or the use of that extra two or three hundred pound of fertilizer to the acre which although producing extra yield, exceeds the limits of optimum economic response per unit of fertilizer applied.

The dominating effect of seasonal rainfall on crop growth in Natal and the wild fluctuations of annual per acre yields which arise as a result of variations in this uncontrollable factor often make it difficult for the grower to assess what is a good working average fertilizer application for his particular holding. The information which has been derived from the fertilizer trials conducted over the past few years, taken in conjunction with data from chemical analysis of field soil samples and previous crop histories, now permits of sound fertilizer recommendations being given to individual growers requiring advice in this respect.

In the field of crop husbandry however, information is much less complete and little is known of the precise effects which many husbandry operations have upon crop yields, or perhaps what is more important, how profitable they are in a given set of circumstances. There is in fact an urgent need to find out how to get the most out of the least — which is a very different proposition from merely finding out how to get the most! It behoves us therefore, to examine critically the whole procedure of crop production and, giving priority to the most expensive operations, to attempt to devise the means of either eliminating them completely or modifying them in such a way as to reduce their cost without impairing their effectiveness.

Thus the ploughing out and re-establishment of a canefield is currently assessed at anything up to £50-£60 per acre, an expenditure which at the best of times is not incurred lightly. How long in a particular set of circumstances can one profitably continue to take ratoon crops? Is it possible to rejuvenate an old ratoon crop by a simple and cheap cultural operation in such a way that the

life of the crop can be extended with enhanced yields for one, two or more ratoons? And if re-planting becomes inevitable, just which and how few operations are essential in order to successfully eliminate the old and establish the new crops? Is it essential to plough in the trash of the last crop at ploughing out, an operation which usually calls for a tracked tractor and special equipment and precludes an early re-establishment? These and many other questions besides are now being asked from all sides.

In some instances a limited amount of experimental evidence supported by intelligent observation both on the part of growers and research and field staff of the Experiment Station permits reasonably safe answers to be given, but much must remain unanswered until more evidence is available.

RESEARCH.

The research programme therefore has been reviewed and those experiments which either by reason of design, location or other causes, are providing but very limited useful information, have been discontinued or are scheduled for discontinuation in the near future, so as to permit new projects of pressing importance to be started.

Thus progress has been made with the establishment of a number of trials to investigate the combined effects of variety, inter-row spacing, and fertilizer rates, and the effects of depth of planting and type of sett on germination and crop yields. Other trials to assess the minimum number and types of operations necessary for crop re-establishment and the practicability of rejuvenating old crops by mechanical means are planned for the coming season.

Important though these problems are for the immediate future it would be most unwise not to project our thinking into the rather more distant future in an effort to anticipate some of the problems which seem most likely to arise.

Thus if the experience of other sugar growing countries can be taken as any criterion, machinery must find an ever increasing place in all phases of production. Present trials as outlined in the foregoing paragraphs will provide information which should permit the development of equipment tailored to the job that is required of it and suited for operation under our various local conditions. The use of machinery in the field however, brings problems in its wake and it would be as well to solve these at leisure now rather than to attempt to improvise a quick answer at a later stage when time is no longer on our side.

Let us look at only two samples of the sort of questions which might be posed.

(a) How important is soil compaction in its effect on yield, how far does the use of infield machinery aggravate its effect and to what extent can it be alleviated?

(b) How does trashing fit in with completely mechanised methods of production and if it is eliminated in order to facilitate mechanized planting, fertilizer placement, chiselling, harvesting, etc. what steps can be taken to maintain the soil in good heart and prevent losses due to erosion?

With the object of seeking the answers to such questions, two new sub-sections have been established at the Experiment Station during the course of the year, one in the Soils Section for the purpose of investigating problems concerning the physical structure of soils and the other in the Pathology Section for investigating problems of microbiology.

Work has already started on studies of compaction and the water relationships of soils in the first and on studies of soil organic matter in the second. The work in progress in both sub-sections is co-ordinated closely with the activities of the Chemistry and Agricultural Sections and will be expanded in the future as the needs arise.

The results of the findings from research projects in progress during the year are outlined in the relevant sections of the main report.

It is appropriate here to refer to a unique event in the history of the Experiment Station which occurred in September 1959 when the first Natal born and bred sugarcane variety was released to the Industry. In the circumstances it seems a pity that the variety in question should have been given a number — and not even Number 1 at that ! — and not a name, like say " Debrett ", which would have indicated that it was the first of a royal line, and perpetuated the name of its breeder at the same time ! N.50/211 it will remain, and though it was released somewhat diffidently the planting community appear to have received it with considerable enthusiasm.

The breeding section, now refusing to admit defeat in any phase of seed production, has again taken a step forward in providing what appears to be a practical method of inducing flowering in even the shyest of flowering varieties.

Ratoon stunting disease remains undoubtedly the major menace to the Industry at present. Nevertheless the mosaic position is far from satisfactory, the more particularly since it has become apparent that the variety N:Co.376, hitherto regarded as fairly resistant to the disease is being increasingly and seriously affected by it. It is not clear as yet whether this is due to breakdown of resistance in the variety or to the presence of a new strain of virus, though there

is some slight evidence of the latter as evinced by the fact that for the first time the yields of the highly mosaic tolerant variety N:Co.339 have been reduced to a noticeable degree. If this is indeed the case then drastic action must be taken to bring the situation under control.

SUGARCANE QUARANTINE.

Under the revised quarantine procedure outlined in the last report, 35 imported varieties are at present housed in the official quarantine station at Stellenbosch. Three varieties from the first two consignments of imported varieties sent to Stellenbosch have now been transferred to the Durban quarantine greenhouse which has been reconditioned and subdivided into a number of separate compartments.

The growth of canes at Stellenbosch has proved to be slower than was anticipated and with the space allocated to cane strictly limited it became apparent that quarantine under the proposed system was likely to be a very protracted procedure.

Following on further representations to the Division of Plant Control and Quarantine when the position was again reviewed, it was agreed that the old arrangements should be reinstated, and that the whole of quarantine revert to Durban. At the time of reporting 40 varieties are now in quarantine in Durban, most of them imported direct from overseas sources.

ADVISORY AND EXTENSION SERVICES.

With the experience drawn from operations over the past two or three years the pattern of these services, which constitute the vital links between research and field practice, has gradually emerged. It seems clear that advisory officers can be most effective if they advise extension staff and not growers direct, and that if the extension service is to be effective it should be absolved from heavy commitments in other fields, such as management of field trials. It is also necessary to reduce the number of growers allocated to each extension officer so as to ensure adequate liaison with individual growers.

Such an approach leads inevitably to a "chain reaction", for reduced commitments in field experimentation for Extension Officers must throw an additional burden on an already hard-pressed Agricultural Section, which must in turn therefore require reinforcement if it is to maintain, let alone expand, its programme of field trials.

The Council of the South African Sugar Association has now accepted plans for the expansion of research and extension services which when put into effect will overcome many of the deficiencies existing in the present organisation.

Experiment Station staff were in attendance at a number of farmers' field days and at meetings of various planters' associations. This form of contact is becoming increasingly popular with both growers and Station staff alike, since not only does it offer unlimited scope for open discussion on a wide range of local problems but it also leads to improved co-operation and understanding in matters of mutual interest.

The Experiment Station has been for some time increasingly concerned by the overall disease situation in the Natal Sugar Industry, and has considered advisable the establishment of a disease inspection service which will provide information on the disease picture in the Industry.

One of the essentials in maintaining the cane crop in a satisfactory state of health is the use of disease-free seed cane. Thus the establishment of well-controlled seed cane nurseries is also being stressed.

Two disease inspectors have now been appointed to the staff of the Experiment Station. One of these inspectors will advise and assist growers with the establishment of seed cane nurseries.

ADMINISTRATION AND SERVICES.

The Director assumed responsibility for all administration and services on his appointment.

Control of transport was centralised and a transport "pool" formed which has led to an appreciable reduction in vehicle strength and some improvement in the effective use of vehicles.

The Building Section completed a useful programme of work during the year, during which a number of additions were made to labourers' accommodation, both Indian and African, at the Experiment Station, the Experimental Farm and the Propagation Farm. A 3-bedroomed house was constructed at Empangeni for the Regional Representative based in Zululand, while at the Experiment Station an extensive programme of improvements to existing houses was undertaken.

DELEGATIONS.

The Chief Research Chemist and Chief Agricultural Officer were nominated to attend the 10th Congress of the International Society of Sugarcane Technologists held in Hawaii in 1959. Both presented papers as did the Soil Scientist. They were able to visit Mauritius and Queensland en route for Hawaii and Louisiana on their way back to South Africa. The reports of their experiences have been published as sections of a report prepared by the South African delegation as a whole.

REPRESENTATION.

The Experiment Station was represented on the following committees by the members of staff noted :

(a) Industrial Field Mechanization and Labour Saving Committee — The Director (co-opted).

(b) Advisory Research Committee of the Sugar Milling Research Institute — The Director and Chief Research Chemist.

(c) Advisory Committee for the Pongola Settlement — The Chief Research Chemist.

J. L. du Toit, Chief Research Chemist, was re-elected Vice-President of the South African Sugar Technologists Association for the year 1959-60.

J. Dick, Entomologist, served on the Council of the South African Sugar Technologists' Association during 1959-60.

ACKNOWLEDGEMENTS.

The Experiment Station acknowledges with grateful appreciation the co-operation received from sister institutions both in Africa and overseas.

Thanks must go also to the many growers and miller-cum-planters without whose active co-operation and assistance it would have been impossible to carry out the extensive programme of regional experiments now in progress.

The quarantine greenhouse in the Botanic Gardens, Durban, used for the introduction of sugarcane varieties into South Africa. This greenhouse is managed by the Experiment Station in cooperation with the Division of Plant Control and Quarantine.

Soils

Soil Scientist: B. E. BEATER

I A DISTRIBUTION OF SOILS.

(a) Soil group classification.

Mapping of geological soil groups has continued in the Eshowe-Entumeni-Nkwaleni areas, all the farms in those districts now having been completed. This involved mapping some 160 estates, with a wide variety of soils.

Among such soils may be listed those derived from Tugela schist, granite, T M S both ordinary and mist belt, Dwyka tillite, Lower Ecca shale, Middle Ecca sediments, dolerite and alluvium. An interesting feature was the occurrence of an extensive area of schist soil under sugarcane west of Entumeni. This latter sector of the Industry lies 30 miles inland and at an altitude of about 2,000 feet. On one estate an occurrence of serpentine rock (hydrated magnesium silicate), yielded a deep red soil much resembling that derived from dolerite, though no cane was actually planted on it.

Extensive areas of mist belt T M S soil were encountered west of Eshowe and again on the Entumeni plateau, while to the south of Entumeni itself was a large area of exceedingly poor T M S soil.

In the Nkwaleni valley an interesting succession of soil groups was mapped, ranging from Middle Ecca soils in the east, passing through Lower Ecca and Dwyka soils to the west. Faulted against these on the northern side of the valley were found T M S, granite and schist soils, while in proximity to and on the large meanders of the Umhlatuzi River, occurred various alluvial soils.

These latter alluvial soils are not confined to the immediate neighbourhood of the river but occur on terraces, often some height above the present river valley. Of particular interest are large areas of highly fertile red loam to clay loam of alluvial origin (Shorrocks Hill series), which, but for the occurrence of water-worn boulders here and there in some profiles, might be confused with red dolerite soil.

Soils of the lower valley (Middle Ecca sediments) did not appear to be so productive as those of the middle and upper reaches of the valley. In addition, as irrigation is practised ubiquitously, it was observed that there was a tendency to alkali accumulation in numerous localities.

As the above areas are now completed, mapping operations have been transferred to the Mposa-Mtubatuba sector.

The following is the *correct nomenclature* for designating the geological soil groups :

Pre-granite quartzite (in sentence, pre-granite)
Tugela schist
Amphibolite (in sentence, amphibolite)
Granite (in sentence, granite)
Table Mountain sandstone
Dwyka tillite
Lower Ecca shale
Middle Ecca sediments (i.e. shale and sandstone)
Beaufort sediments (i.e. shale and sandstone)
Stormberg sediments (i.e. shale and sandstone)
Dolerite, Basalt (in sentence, dolerite, basalt)
Cretaceous sediments (i.e. shale, sandstones and marls)
Recent Sands (red)
Recent Sands (grey)
Alluvium (in sentence, alluvium)

(b) Soil cartography.

Computation of areas of soil groups both on the whole estate and under cane is continuing. The total area surveyed during the year was approximately 100,000 acres, covering almost all the known sugarcane soil groups. Painting of field maps onto linen copies is being continued.

(c) Cane areas map.

Considerable effort has been put into preparing a map on the scale of 1/500,000 of the sugar belt, in which areas owned by European, Indian and Bantu planters are separately depicted. This has now been finally prepared and printed in colour for circulation and incorpooration in the Year Book of the Industry.

(d) Soil sampling.

The occasional sampling of soils for information supporting the classification programme has been continued. This has particularly been the case in the Nkwaleni valley, where alluvial soils are occasionally rather difficult to distinguish from primary soils.

B CLASSIFICATION OF SOILS INTO SERIES.

As is well known, the survey of the soils of the sugar belt has hitherto only concerned itself with broad genetic soil grouping, according to derivation from underlying rock. The necessity for a more detailed form of classification, using soil series, was continually born in mind, but owing to the vast area involved it became necessary to concentrate on the broad classification first.

In the course of the general survey, attention was constantly focused on this future important work by the study of numerous test pits and soil profiles.

Of the four categories commonly recognised in the classification of soils viz. (1) Group (2) Series (3) Type and (4) Phase, the most important of these is the *soil series*, defined as those soils having horizons similar as to differentiating characteristics and arrangements in the soil profile, and evolved from a particular type of parent material.

Where agriculture is intensive, and where the soil management practices are very specific, as in sugarcane cultivation, the need is for a precise definition of series according to the relevant properties of the profile. It should always be realised that the soil profile is the final criterion of classification and not merely such single aspects as surface soil, parent rock and so forth. The soil profile is a unit which is evolved, and which has developed characteristics peculiar to itself under the existing conditions of climate. It is recognised by its division into horizons or distinctly apparent zones of chemical and physical differentiation.

One frequently observes, for example, a layer of ironstone gravel in a soil. This is what is meant by an horizon, a particular zone which has differentiated itself. Other horizons may be characterised by an accumulation of lime nodules near the base of the profile. Others again by a hard pan formation, which may be regarded as a zone of illuviation or accumulation. All these matters go to show once more that a soil must be assessed by its whole body and not by simple observation of its superficial character.

The soil series name is a geographical one and usually refers to the locality where the series was first established. The soil type takes into consideration the textural composition of the surface soil alone, and embraces the geographical name, thus Williamson fine sandy loam.

In the light of what has been said above, the soil survey as undertaken so far has been essentially a preliminary to the further sub-division of the soils of the sugar belt into soil series. The basis for this preliminary survey has been geological, since soils in this region are so closely allied to the underlying rock. In other words a simplified vehicle for carrying or "pigeon holing" our knowledge of the soils has now been obtained. It is not intended that one should discontinue thinking in terms of geological soil groups, i.e. referring to soils as Dwyka soils, Ecca soils and so forth; but in the course of our agronomic research it is of utmost importance to go further and plan in terms of soil series, which latter undoubtedly have some selective effect on plant growth.

As an example of this, two profiles from a dolerite soil may be quoted. Dolerite soils can have a deep red acid profile, or a shallow blackish profile which becomes strongly alkaline below. Such differentiation is accounted for in the series classification, the first series being known as the Shortlands series and the second as the Rydal Vale series. Not only may such profiles vary in their reaction to plant growth, but they may also possess varying physical properties, such as permeability, erodability and particle size distribution. Among virgin soils, the natural vegetation is frequently itself a guide to the underlying profile, particularly in regard to soils which may have evolved alkaline horizons.

Thus agronomic research and practice are primarily dependent on a knowledge of soil profile characteristics, and thereby the soil series.

It will be appreciated that the mapping of soil series presents a number of difficulties. In the first place, soil series are so closely integrated that very detailed mapping is required to resolve them and such detail cannot conveniently be recorded on maps of much less detail than 1/25,000. Maps of 1/6,000 scale of each individual estate in the sugar belt are in the possession of the Industry and are eminently suitable for detailed mapping of soil series. It is intended to embark upon this project in the future, focusing attention in the first stages on sites where various agronomic experiments are in progress. The prospects of completing a series survey of the entire sugar belt must be regarded as rather remote for the present, owing to the complexity of the soils encountered and to the fact that, unlike in the present

survey, details of the soils to be mapped are not largely apparent from surface characteristics.

As previously mentioned, a beginning has already been made with regard to the series classification. This has been possible due to extensive observational studies during the present soil group survey. To date thirty-two soil series have been established, but this number will possibly have to be added to from time to time, though it is not anticipated that many more will actually be encountered. A great deal of information has been obtained, both in the field and the laboratory about these recorded series, part of this information being published in Parts One and Two of the sugar belt survey.

The following is a brief outline of the soil groups and sub-groups of the Sugar Industry together with most of the associated soil series and their essential characteristics :

GEOLOGICAL SOIL GROUP	SOIL SERIES	BRIEF DESCRIPTION OF SURFACE SOIL AND PROFILE
Pre-granite quartzite	Humberdale	Moderately deep greyish loamy coarse sand of single grained structure and loose to partly friable consistency. Profile becomes slightly compact and cemented with depth. All horizons are acid in reaction. Soil Type :— Humberdale loamy coarse sand.
Amphibolite	Dansland	Rather deep blackish clay loam of granular to nutty structure and rather friable consistency. Becomes more compact with depth, the profile remaining acid throughout all horizons. Soil Type :— Dansland clayey loam.
Tugela schist	Glendale	Moderately deep reddish brown loam to clayey loam of granular to coarse nutty structure and friable to compact consistency, becoming compact with depth. Acid to moderately acid throughout the profile. Soil Type :— Glendale clayey loam.
	Logoza	Very deep reddish brown loam to clayey loam of granular to nutty structure with friable to compact consistency. The profile is rather uniform and acid to moderately acid throughout. Soil Type :— Logoza clayey loam.
Granite	Glen Rosa	Rather shallow light greyish brown gritty loam, crumby structure and friable consistency. Becomes rather cemented lower down profile with much coarse grit. All horizons are acid. Soil Type :— Glen Rosa gritty loam.
	Mayo	Very dark greyish coarse gritty loam of crumby to granular structure and friable consistency. Profile tends to become cemented with depth, and remains acid throughout. Soil Type :— Mayo coarse loam.
	Eldorado	Rather shallow light grey coarse sandy to gritty loam of crumby structure and loose to partly friable consistency. Profile becomes slightly compact with depth and is acid throughout. Soil Type :— Eldorado fine gritty loam.

GEOLOGICAL SOIL GROUP	SOIL SERIES	BRIEF DESCRIPTION OF SURFACE SOIL AND PROFILE
Table Mountain sandstone	Cartref	Moderately deep light pinkish grey coarse sandy loam of single grained to crumby structure and loose to friable consistency. The profile is rather uniform and acid in all horizons. Soil Type :— Cartref coarse sandy loam.
	Trevanian	Moderately deep greyish brown coarse sandy loam of crumby structure and friable to slightly compact consistency. This series is transitionary between Cartref and Inanda, the profile being also acid throughout. Soil Type :— Trevanian coarse sandy loam.
	Inanda	Deep reddish brown to dark brown loam to clayey loam of crumby structure and friable consistency. Organic matter is very high and all horizons are strongly acid. Soil Type :— Inanda clayey loam.
Dwyka tillite	Williamson	Rather shallow dark grey fine sandy loam of crumby structure and friable to slightly cemented consistency, becoming very compact with depth. Slightly acid but alkaline below rubble horizon. Soil Type :— Williamson fine sandy loam.
	Waldene	Rather deep dark grey brown fine sandy loam of crumby structure and friable consistency. Invariably an ironstone gravel layer is present, the profile being moderately acid to begin with but strongly alkaline below. Soil Type :— Waldene fine sandy loam.
Lower Ecca shale	Milkwood Kraal	Rather shallow dark grey brown loam to clayey loam of crumby to nutty structure and slightly compact consistency. Abundant rubble is present. The profile is moderately acid, but alkaline below. Soil Types :— Milkwood Kraal rubbly loam, Milkwood Kraal clayey loam.
	Phoenix	Deep, rather dark grey brown to blackish clayey loam of crumby to nutty structure and friable consistency. The profile tends to become plastic with depth and rather alkaline. Some transported soil may constitute surface horizon. Soil Type :— Phoenix clayey loam.
Middle Ecca sediments	Mt. Edgecombe	Rather deep dark grey brown sandy loam to loam of crumby structure and friable to slightly cemented consistency. The ironstone gravel layer is usually conspicious, the pH value above being acid but strongly alkaline below. Soil Types :— Mt. Edgecombe loam. Mt. Edgecombe sandy loam.
	Avoca	Rather deep greyish coarse sandy loam of single grained to crumby structure and loose to friable consistency. The profile is uniform and usually acid throughout. Soil Type :— Avoca coarse sandy loam.

GEOLOGICAL SOIL GROUP	SOIL SERIES	BRIEF DESCRIPTION OF SURFACE SOIL AND PROFILE
Middle Ecca sediments (Continued)	Windermere	Fairly deep very dark grey brown clayey loam of crumby to nutty structure and friable to compact consistency. The profile becomes very compact with depth and moderately alkaline lower down in the profile. Soil Type :— Windermere clayey loam.
Beaufort sediments	Nyoka	Moderately deep light greyish brown loamy fine sand of crumby structure and friable consistency, ironstone gravel or rubble occurring within the profile. The surface is acid but becomes rather alkaline below, in many cases with the formation of lime concretions. Soil Type :— Nyoka loamy fine sand.
Stormberg sediments	Pogela	Rather shallow light greyish coarse sandy loam of crumby structure and friable consistency. The profile which is generally acid, terminates abruptly on the underlying rock. Soil Type :—Pogela coarse sandy loam.
Karroo dolerite and Stormberg basalt	Shortlands	Very deep reddish or chocolate clay loam to loamy clay of granular to nutty structure and friable to slightly compact consistency. The profile is very uniform throughout and moderately acid in reaction. Soil Type :— Shortlands clayey loam.
	Rydal Vale	Moderately deep dark grey brown to blackish loam to clayey loam of granular to nutty structure and friable to compact consistency. Ironstone gravel occurs and the profile becomes very alkaline with depth. Soil Types :— Rydal Vale loamy clay, Rydal Vale clayey loam.
Dolerite	Effingham	Moderately deep dark grey brown loam of crumby structure and friable consistency. The profile which is acid is developed from a contaminated dolerite. Soil Type :— Effingham loam.
	Sprinz	Very deep reddish brown clay loam of crumby to granular structure and friable consistency, tending to be plastic lower in the profile. The soil reaction is markedly acid with a high accumulation of organic matter. Soil Type :— Sprinz clayey loam.
Cretaceous sediments	Haig	Rather shallow dark brown to blackish clay loam of granular to nutty structure and friable to compact consistency. The slightly acid surface soil becomes rather alkaline with depth. Soil Type :— Haig clayey loam.
	Green's Island	Moderately deep dark grey brown sandy loam to loam. The surface soil is acid, but profile becomes alkaline with depth.

GEOLOGICAL SOIL GROUP	SOIL SERIES	BRIEF DESCRIPTION OF SURFACE SOIL AND PROFILE
Recent Sands (red)	Clansthal	Very deep light reddish brown coarse sand of single grained structure and loose consistency. The profile which is acid often passes into reddish sandy clay. Soil Types :— Clansthal coarse sand, Clansthal sandy loam.
	Lytton	Very deep reddish brown coarse sand of single grained structure and loose consistency. Profile which is acid passes abruptly into and is featured by reddish sandy clay. Soil Types :— Lytton coarse sand, Lytton sandy loam, Lytton coarse sandy clay.
Recent Sands (grey)	Fernwood	Very deep light greyish coarse sand of single grained structure and loose consistency. Profile which is acid may pass into clayey sand, but is usually sandy throughout. Soil Types :— Fernwood coarse sand, Fernwood fine sand.
	Warrington	Rather greyish to grey brown coarse sand of single grained structure and loose consistency. The profile which is rather acid, is featured lower down by a yellowish grey sandy clay. Soil Types :— Warrington coarse sand, Warrington fine sand.
Alluvium	Blackburn	Dark brown loam of crumby structure and rather friable consistency. Profile is featured by alternating layers of sand, clay loam etc., and is usually neutral to alkaline throughout. Soil Types :— Blackburn coarse sand, Blackburn silty loam, Blackburn clayey loam.
	Sinkwazi	Very dark grey brown silty or clayey loam of crumby to nutty structure and friable to slightly compact consistency. The profile which is usually acid, becomes rather plastic and sticky with depth. Soil Types :— Sinkwazi clayey loam, Sinkwazi silty clay.
	Shorrock's Hill	Deep reddish brown loam of crumby structure and friable consistency. The profile which is acid to neutral occurs mostly in semi-arid river valleys often overlying pebbles or boulders. Soil Types :— Shorrock's Hill loam, Shorrock's Hill clayey loam.
	Mposa	Brownish black to blackish peat loam of variable structure but rather friable consistency. Profile is strongly acid and particularly high in undecomposed plant residues. Water table often near surface. Soil Type : Mposa peat loam.

II CHEMICAL PROPERTIES OF SOILS.

(a) Total and available nutrients.

Owing to the uncertain values sometimes obtained by commonly used methods it was decided to carry out a full investigation of a number of chemical methods on soil samples taken from twenty-four 3 x 3 x 3 fertilizer trials of known yields, the samples of which were combined to yield the respective N, P and K treatments.

On these samples total phosphate was obtained by treatment with perchloric acid, and available phosphate by each of the six methods selected for examination. This constituted a considerable programme of laboratory work; approximately 2,000 analyses in all.

The project was considered worth while in view of the great importance of the subject. Research is continuing in co-operation with the Plant Nutrition Section, in the hope that in due course a fairly satisfactory method of assessing the phosphate needs of the soil will be arrived at.

(b) Other components.

Exchangeable bases were determined on a number of samples from regional fertilizer trials, in order to provide fundamental information regarding the soils of these sites.

(c) Salinity and natural waters.

A number of soil samples suspected of alkalinity and acidity was analysed during the year. Alkali soils are frequently encountered in the drier areas of the Industry where irrigation is extensively practised.

Extreme acidity frequently accumulates in the highly organic soils associated with certain low-lying areas within the grey sands of Zululand (Mposa peat loam). pH values as low as 2.5 have been encountered due to the decomposition of organic material liberating free acid. Amendments in the form of lime applications have been recommended.

Sundry water samples were also analysed on occasion mainly in respect to their suitability for irrigation. They varied from almost pure to extremely saline waters in the northern regions of the Industry, especially where waters issuing from basalt country are encountered.

III PHYSICAL PROPERTIES OF SOILS.

Special emphasis has been placed on this aspect of soil research, as it was felt that insufficient work had been carried out in the past on the problems arising from adverse soil-water relationships. Instruments and apparatus for scientifically assessing the physical condition of the soil have been and are being acquired and preliminary investigations are now under way.

The programme of research involves the movement of water through the soil in water logged areas (drainage), rates of infiltration of water into the soil, field capacity, wilting point, moisture retention properties (pF) and problems arising from the passage of transport over the soil (compaction). Assessing the physical properties of soils along scientific lines is a new venture in this Industry, but its benefits should become apparent.

IV MISCELLANEOUS.

Soil temperatures.

The past year saw the establishment of an undertaking which it is felt will provide useful information in a rather neglected sphere. This comprises the recording of soil temperatures, and for the purpose twelve centres have been selected within the Industry, as follows :

Port Shepstone, Glen Rosa, Illovo, Stony Hill, Mt. Edgecombe, Wartburg, Darnall, Gingindhlovu, Eshowe, Nkwaleni, Empangeni, Mtubatuba.

At each of these centres thermometers yielding temperatures at 1″, 4″ and 9″ depths as well as maxima and minima at the surface have been established both on bare ground and under a normal trash cover.

Temperatures are read daily at about 3 p.m. and the recorded information is returned to the Experiment Station at the end of every month where all results are tabulated and co-ordinated. The scheme was established in late summer and is expected to provide useful data, especially during the winter months. Results to date, show that the surface soil is subjected to temperatures frequently approaching 140° F on bare ground, with a diurnal variation of as much as 80° F, while the temperature at 9″ shows little variation. As is expected, the trash cover exercises an insulating effect, which is being clearly demonstrated by the interesting records now being received.

Plant Nutrition

Chief Research Chemist: J. L. du TOIT

FERTILIZER RESPONSES

Regional Fertilizer Trials.

During recent years there has been an enormous increase in the usage of potassic and nitrogenous fertilizer in the Industry, while the use of phosphatic fertilizer has remained static and has in some years even declined. These changes in practice were supported by experimental data which have shown an increasing general response to potash and in some cases an economic response to nitrogen at levels much higher than was anticipated. Phosphate reserves have in the past been built up with the result that responses to phosphate have not been so spectacular as in the past. In addition there has been a considerable accumulation of experimental data on phosphates and not nearly as much on potash and the expensive nutrient, nitrogen.

The result was that in the more ambitious regional fertilizer experiment series which was to replace the old exploratory 3 x 3 x 3 NPK trial more emphasis was placed on nitrogen and potash than on phosphate and in these factorial experiments there were four levels of nitrogen, only two levels of phosphates and three levels of potash. Forty-seven of these experiments are at present in existence. They were sited so as to cover all conditions and soil groups in the Industry in order to be able to generalise their results for the Industry as a whole and to find possible differences in responses, particularly to nitrogen, for different soil groups.

Past experience has indicated higher plant cane responses to nitrogen on the three soil groups — Table Mountain sandstone mist belt soils, Table Mountain sandstone soils, and granite soils. Consequently for these soils the levels of nitrogen used for plant cane were 60, 120, 180, 240 lbs. N per acre as ammonium sulphate while for all other soils the levels of the same fertilizer used were 0, 50, 100 and 150 lbs. N per acre. The higher level of phosphate was always 200 lbs. P_2O_5 per acre as superphosphate but the lower level was either zero in the case of a soil high in phosphate or 100 lbs. P_2O_5 per acre in a soil low in available phosphate or where a response to phosphate was expected. Potash dressings were all with muriate of potash at the rate of 0, 100 and 200 lbs. per acre K_2O.

This series of experiments has undoubtedly increased our knowledge with respect to responses to nitrogen and potash in plant cane and it is certain also to do the same for ratoons when these are cut. Selection of uniform sites based on soil analyses and probably the larger plot sizes used, about 1/14 acres nett, have reduced the standard error in these experiments. In retrospect it must be regretted that zero treatments were not always used for nitrogen and phosphate as was done for potash and that three levels of phosphate were not used. The result is that the clearest picture emerges for responses to potash and very little information is gained on phosphates.

So far forty of these experiments have been harvested as plant cane and of these 23 had zero nitrogen treatments, 17 had the 60, 120, 180, 240 lbs. N per acre applications. The average responses to nitrogen for the latter applications were as follows :

TABLE I

	TREATMENT	Tons cane per acre	Tons sucrose per acre
N1	60 lbs. N per acre	52.75	7.82
N2	120 lbs. N per acre	55.58	8.27
N3	180 lbs. N per acre	56.15	8.20
N4	240 lbs. N per acre	57.35	8.32

It is clear from these figures that with the present ruling prices it is economic to apply on the average 120 lbs. N per acre to plant cane in soils derived from Table Mountain sandstone (including the mist belt soils) and from granite, but that higher applications are not warranted.

The mean result obtained from the other 23 trials is as follows :

TABLE II

	TREATMENT	Tons cane per acre	Tons sucrose per acre
N1	0 lbs. N per acre	38.83	6.08
N2	50 lbs. N per acre	41.65	6.44
N3	100 lbs. N per acre	43.59	6.67
N4	150 lbs. N per acre	44.62	6.73

The economic optimum yield response here lies between 50 and 100 lbs. N per acre but appears to vary with the soil group. The indications are that Dwyka soils may need 120 lbs. N, Recent sands gave an optimum economic return at only 50 lbs. N and average responses to nitrogen in plant cane on dolerites and Ecca shales are even lower.

The average responses to potash in these forty trials were considerably better than the mean responses in the old 3 x 3 x 3 trials as is shown in Table III :

TABLE III

	TREATMENT	Tons cane per acre	Tons sucrose per acre
K1	0 lbs. K_2O per acre	44.99	6.73
K2	100 lbs. K_2O per acre	48.35	7.30
K3	200 lbs. K_2O per acre	50.12	7.61

In about half the trials the responses to potash proved statistically significant and on the average 200 lbs. K_2O per acre applications were highly economic.

3 x 3 x 3 Trials.

Of the original 3 x 3 x 3 experiments, six were cut as third ratoons. All previous crop yields were recorded and a comparison of these results is interesting and shows that the response to nitrogen in plant cane is small compared with that of the ratoons. (See Table IV.)

Miscellaneous Trials.

An experiment where high levels of nitrogen have been used under dry land conditions has created considerable interest. This experiment situated on a Dwyka soil was started as a second ratoon and has now been harvested as a fifth ratoon and the sixth ratoon is at present in excellent condition where adequate nitrogen has been used. Some of the results obtained have been given in previous reports but these are here repeated in tons cane per acre so as to compare them with the latest results. (See Table V.)

TABLE V

Treatment — TONS CANE PER ACRE.

In lbs. N per acre	2nd Ratoon	3rd Ratoon	4th Ratoon	5th Ratoon
Age in months	21	21	17	19
0	34.47	35.22	32.74	43.55
100	38.05	38.04	39.61	45.06
200	36.86	43.11	42.52	45.81
300	36.35	51.42	47.07	50.08
400	40.13	55.54	48.76	51.05
500	42.51	59.67	48.37	46.66
600	41.13	52.75	46.89	46.85

The disappointingly low responses in second ratoons were undoubtedly due to other deficiencies, primarily potash which was shown by leaf analyses to be quite inadequate in this second ratoon where no potassic top dressing was applied. With generous top dressings of muriate of potash and superphosphate on the later ratoons, excellent responses to nitrogen were shown in the third and fourth ratoons. There was, however, distinct evidence of the high fertilizer affecting adjacent plots and this is the probable reason for the lower response in the fifth ratoon. In all cases there appears to be a depression in the yield of cane per acre to the highest level of nitrogen used and generally the sucrose per cent cane was down as well.

Similarly the effect of high levels of potash is being tested out on the same soil group. The experiment has now been harvested as a third ratoon and in addition to the potash dressing all plots had a top dressing of 300 lbs. N per acre and 400 lbs. superphosphate. The results are given in Table VI :

TABLE IV

TREATMENT. — YIELDS IN PLANT CANE AND RATOONS.

lbs. per acre	Plant Cane		1st Ratoon		2nd Ratoon		3rd Ratoon	
	Tons cane per acre	Tons sucrose per acre	Tons cane per acre	Tons sucrose per acre	Tons cane per acre	Tons sucrose per acre	Tons cane per acre	Tons sucrose per acre
N0 0 N	56.21	8.60	47.18	7.33	42.79	6.32	40.12	6.01
N1 100 N	56.61	8.71	51.55	8.10	49.63	7.34	45.67	6.77
N2 200 N	57.69	8.85	55.43	8.40	50.52	7.31	47.75	7.02
P0 0 P_2O_5	54.92	8.45	49.03	7.66	45.19	6.67	41.54	6.23
P1 100 P_2O_5	56.27	8.60	51.12	7.80	47.16	6.93	45.14	6.69
P2 200 P_2O_5	59.32	9.12	54.01	8.38	50.59	7.37	46.87	6.89
K0 0 K_2O	54.14	8.28	47.08	7.28	41.46	6.00	38.20	5.68
K1 100 K_2O	57.83	8.88	51.79	7.90	50.41	7.45	47.47	7.05
K2 200 K_2O	58.54	9.00	55.30	8.67	51.08	7.56	47.87	7.08

TABLE VI

Treatments Lbs. K_2O per acre	Tons cane per acre	Tons sucrose per acre
0	49.66	8.24
120	57.45	9.56
240	55.59	9.08
360	59.62	9.88

Once again the results show that while an excellent response is obtained from the application of 200 lbs. per acre muriate of potash higher dressings are not economically warranted. In this respect the result agrees largely with the results of the 3 x 3 x 3 series of experiments but not necessarily with those of the Regional Fertilizer Trial series which have been described and which show rather better response to potash in plant cane

The correct fertilizer balance is becoming of increasing importance in the Industry and it is therefore very necessary to ascertain the best ratio of nitrogen to potash to be applied. To elucidate this point some experiments have been started using a 5 x 5 factorial design with two replications and using nitrogen and potash in steps of a 100 lbs. N or K_2O per acre from 0 to 400 lbs. An overall dressing of 800 lbs. per acre superphosphate was applied. One such experiment situated on a Table Mountain sandstone soil has now been harvested as a plant cane crop. The results obtained are shown in Tables VII and VIII.

Both for tons cane per acre and tons sucrose per acre N and K show highly significant effects of curvature and highly significant interactions. Nitrogen depresses yields in the absence of potash but increases it in the presence of potash. The danger of applying too much expensive nitrogen on this low potash soil is obvious. Similarly the effect of potash without adequate nitrogen is disappointing. The best ratio of N to K_2O cannot be determined with any degree of exactitude from one experiment but it does seem to lie between 1 : 1 to 1 : 2 for this experiment as plant cane. The most profitable treatments were 100 lbs. N per acre with either 100 or 200 lbs. K_2O per acre which yielded a profit in excess of £25 per acre due to fertilizer applications.

The millable cane was analysed at harvesting and the amount of nutrients removed for the crop can therefore be calculated. (See Table IX.)

TABLE VII

MEAN TONS CANE PER ACRE.

	N0	N1	N2	N3	N4	Mean
K0	28.12	26.02	24.72	24.36	22.64	25.17
K1	32.58	41.85	42.54	37.16	36.14	38.05
K2	29.66	46.84	41.18	43.14	45.28	41.22
K3	34.32	41.38	38.20	46.26	42.61	40.55
K4	29.54	43.94	46.48	49.96	35.88	41.16
Mean	30.85	40.01	38.62	40.18	36.51	37.23

S.E. of body of table — 3.42
S.E. of marginal means — 1.53

TABLE VIII

MEAN TONS SUCROSE PER ACRE.

	N0	N1	N2	N3	N4	Mean
K0	4.88	4.30	4.01	3.86	3.56	4.12
K1	5.54	7.64	7.33	6.08	5.92	6.50
K2	5.14	8.06	7.25	7.41	7.96	7.17
K3	6.21	7.26	6.76	8.17	7.28	7.14
K4	5.15	7.76	7.94	8.50	6.24	7.12
Mean	5.38	7.60	6.66	6.80	6.19	6.41

S.E. of body of table — 0.58
S.E. of marginal means — 0.26

TABLE IX

lbs. removed.

	N	P_2O_5	K_2O
N0	43	27	42
N1	60	26	61
N2	73	25	51
N3	93	21	49
N4	89	20	47
K0	49	21	22
K1	73	24	34
K2	84	26	66
K3	73	22	66
K4	74	25	69

It is interesting to note that with increased nitrogen applications there is a drop in total phosphates removed. The actual concentration of phosphates in cane shows of course a much greater drop with nitrogen application. Similar results were obtained on cane analyses when sampled at a younger age. No account is here taken of the nutrients in tops, trash and roots.

The exchangeable potash in soil was determined before planting the experiment and again after harvest. The results on the top 10 inches of soil were as follows :

TABLE X

ppm. K_2O in soil.

	Before planting	After harvest
K0	77	73
K1	78	78
K2	77	90
K3	77	131
K4	75	141

These analyses show that under these conditions the fall in exchangeable potash was slight in the case of no potash application and there was a progressive gain for applications of 200 lbs. K_2O per acre and more but these do by no means account for the total application even when total depletion losses in the crop are considered. It is of course possible that part of the potash has moved down to deeper depths but will still be available to the crop.

Leaf analyses done on this experiment are shown in Table XI.

The leaf analysis does not show a drop in phosphate content with increasing dressings of nitrogen; but as stated analyses of the millable cane show a very distinct drop. Millable cane analysis, soil analysis and leaf analysis all showed a marked potash shortage and the excellent response was therefore not unexpected.

ANALYTICAL DATA AND YIELD RESPONSES.

It is most fortunate that responses to potash can be predicted fairly accurately from either leaf or soil analyses, as they can from analyses of millable cane or whole cane.

Statistical analyses done on accumulated data from the Regional Fertilizer Trial series have shown that there is no significant effect of age of cane on the potash composition of the leaves and this of course is most helpful in interpreting results.

In examining correlations between potash yield responses and analytical data the following symbols will be used :—

w = K_2O per cent millable cane in K1 plots (wet basis)

TABLE XI

Samples taken	12/3/1958			1/5/1958			15/12/1958		
Treatment	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
N0	1.95	.55	1.08	1.89	.47	.89	1.89	.47	.89
N1	2.17	.57	1.05	2.02	.46	.85	2.02	.46	.85
N2	2.07	.54	1.15	2.10	.49	.99	2.10	.49	.99
N3	2.17	.54	1.08	2.10	.48	.92	2.10	.48	.92
N4	2.16	.54	1.03	2.07	.45	.92	2.07	.45	.92
K0	2.07	.55	.80	2.04	.48	.69	2.04	.48	.69
K1	2.10	.54	1.10	2.04	.46	.90	2.04	.46	.90
K2	2.13	.56	1.14	2.03	.48	.97	2.03	.48	.97
K3	2.10	.54	1.14	2.06	.48	1.00	2.06	.48	1.06
K4	2.14	.56	1.19	2.03	.47	1.01	2.03	.47	1.01

x = K_2O per cent third leaf laminae in K1 plots (dry basis)

y = Average yield response in tons sucrose per acre i.e.

$$\frac{(K2 - K1) + (K3 - K1)}{2}$$

z = Exchangable K_2O in ppm. in the soil.

The correlation coefficients found were :

			5%	1%
$\sqrt{wy} = -.608$	significant	levels	.321	.413
$\sqrt{xy} = -.619$	significant	levels	.313	.403
$\sqrt{zy} = -.538$	significant	levels	.313	.403
$\sqrt{xz} = +.700$	significant	levels	.313	.403

The average responses obtained within certain ranges of analytical data are of interest, and are shown in Table XII.

Responses to potash are now very common in the Industry and the generally low analytical results obtained provide an explanation for this fact, but the danger of disregarding analytical results and applying potash everywhere because the Industry as a whole is short of potash is amply illustrated in the table XII. With a high analysis, practically no response can be expected and although actually statistically significant depressions due to potash application have not been obtained in this series of experiments, the general downward and negative tendency in yield at the highest applications of potash on soils high in potash cannot be ignored.

The ageing of cane gave a very highly significant depression of leaf phosphate, the average drop in percentage P_2O_5 content from 3 to 7 months being approximately 0.13, 0.07, 0.06, 0.03 per month. After ten months no further regular drop was found. Phosphate content is further significantly increased by rainfall and also affected by season. Earlier reports, however, have shown that by confining sampling to the period of optimum growth and for a specified age of cane, leaf analyses can give very useful indications of responses to fertilizer.

Of the soil phosphate extraction methods tried out, quite a number gave significant correlation coefficients with response to phosphate in the 3 x 3 x 3 series. Taking all soil groups analysed the best results were obtained from 0.02 N H_2SO_4 and 0.1 N NaOH extracting solutions. The action of these two extracting solutions are however quite different and largely different forms of phosphate are extracted. The subject of phosphate extractions from soils is still under investigation.

The nitrogen content of cane leaves, as was the case with phosphate, falls significantly with age. The drop is very rapid during the first few months and after the third month the drop in per cent nitrogen is approximately 0.17, 0.14, 0.13, 0.10, 0.07, 0.05, 0.03 and thereafter decreasing by about 0.028 per cent per month.

Although nitrogen application certainly increases the nitrogen composition of the leaves, no overall correlation could be found between the nitrogen content of the control plots and final response to nitrogen in the Regional Fertilizer Trials series. In fact the correlation coefficient found was only — .04 for 39 plant cane trials which is of course quite insignificant. The correlation between millable cane analyses and yield responses was found to be r = — .305 where a figure of .312 is required for a 5 per cent level of significance for the 40 plant cane trials. Once again significance is not reached but the results are such as to encourage further research to find a part of the cane stalk which when analysed during a certain period or cane age may reflect nitrogen response.

It is unfortunate that better means of assessing responses to nitrogen are not available. At the moment advice on nitrogen applications must be based on generalised results from fertilizer trials with due consideration to soil groups.

TABLE XII

Range w	No. of Trials	y	Range x	No. of trials	y	Range z	No. of trials	y
< .05	9	1.41	< .80	8	1.22	< 75	10	0.99
.05 — .079	7	0.96	.80 — .89	5	1.03	75 — 99	5	0.84
.08 — .099	4	0.84	.90 — .99	7	0.69	100 — 124	10	0.98
.10 — .199	15	0.30	1.00 — 1.09	6	0.75	125 — 149	4	0.72
.20 — .299	1	— 0.51	1.10 — 1.19	3	0.94	150 — 174	1	— 0.40
> .299	2	— 0.40	1.20 — 1.29	2	0.12	175 — 199	3	0.03
			1.30 — 1.39	2	0.09	200 — 224	1	— 0.28
			> 1.39	7	— 0.02	> 244	5	— 0.37

CANE COMPOSITION.

To asses the amount of nutrient removed in millable cane, composite samples of cane from the main treatments are analysed at the time these are brought in for sucrose analyses. In the Regional Fertilizer Trial series a large number of plant cane crops has now been harvested and the average composition of the crops may therefore be summarised.

TABLE XIII

Treatment	Lbs. N applied per acre.	Per cent N on Millable cane.
N1	60	0.073
N2	120	0.082
N3	180	0.089
N4	240	0.097
N1	0	0.069
N2	50	0.073
N3	100	0.075
N4	150	0.090

Where phosphates were applied the results were as follows :

TABLE XIV

Treatment	Lbs. P_2O_5 applied per acre.	Per cent P_2O_5 Millable cane.
P1	0	0.048
P2	200	0.046
P1	100	0.034
P2	200	0.036

The experiments where the control phosphate plots received no phosphate were those which on soil analyses were considered well supplied with phosphates and where no responses to phosphate were anticipated. It will be seen that the general level of phosphate in millable cane was appreciably higher in these cases than when the lowest level of phosphate was 100 lbs. per acre. P_2O_5 and where some response was expected.

The potash content of millable cane was as follows :

TABLE XV

Treatment	Lbs. K_2O applied per acre.	Per cent K_2O Millable cane.
K1	0	0.108
K2	100	0.121
K3	200	0.138

The mean level of the K_2O in control plots 0.108 is low and means that a ton of millable cane will carry away to the mill just over 2 lbs. of K_2O. This figure although in general low is extremely variable. Thus in some cases of potash deficiency a ton of cane will contain only 0.7 or 0.8 lbs. K_2O whereas in trials on high potash soils the control plots contained 6 to 7 lbs. K_2O per ton of cane.

There are often considerable varietal differences in the composition of millable cane, and foliar diagnosis, useful as it is for predicting responses to potash and phosphate, often does not reflect these variations accurately. In a variety trial cut the yields, cane composition and lbs. nutrients removed per acre are shown in Table XVI.

In this experiment Co.331 gave the best yield of cane per acre but Co.331 has a nutrient composition appreciably lower than the other varieties, with the result that the amounts of nutrients in the crop of Co.331 is less than that of practically all other varieties. Leaf analyses done on this experiment during its optimum growing stage reflected the differences in cane composition reasonably well. The leaf analyses were as shown in Table XVII.

TABLE XVI

Variety	Tons cane per acre.	Millable cane % composition.			Lbs. per acre in cane.		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O
N:Co.292	25.04	.159	.038	.226	80	19	113
N:Co.293	37.90	.154	.031	.241	117	23	183
N:Co.382	35.70	.155	.026	.270	111	19	193
Co.331	38.66	.112	.024	.178	87	19	138
N:Co.339	28.06	.151	.035	.363	85	20	204
N:Co.376	30.56	.188	.035	.327	115	21	199

TABLE XVII

	N	P_2O_5	K_2O
N:Co.292	2.21	.57	1.72
N:Co.293	2.25	.53	1.56
N:Co.293	2.24	.56	1.58
Co.331	2.12	.49	1.54
N:Co.339	2.43	.61	2.01
N:Co.376	2.58	.63	1.82

INCREASED SOIL ACIDITY.

The soils of the sugar belt are gradually becoming more acid. It is known that most nitrogenous fertilizers have an acidifying effect on soil and that ammonium sulphate is particularly drastic in this respect. In the Regional Fertilizer Trial series, all nitrogen was applied as ammonium sulphate and the pH values were taken before planting and after harvesting the plant cane crop. The recorded pH values were as follows :

TABLE XVIII

Treatment	Lbs. N per acre.	pH at start.	pH after Harvest.	Drop in pH.
N1	60	5.43	5.29	0.14
N2	120	5.41	5.22	0.19
N3	180	5.38	5.02	0.36
N4	240	5.34	4.98	0.36
N1	0	6.10	5.89	0.21
N2	50	6.14	5.89	0.25
N3	100	6.10	5.87	0.23
N4	150	6.06	5.68	0.38

There is a drop of pH in all instances even where no nitrogen had been applied, and when heavy dressings of ammonium sulphate had been applied the drop amounts to more than one third of a unit of pH.

The average pH of the different soil groups at the time of planting was as follows :

TABLE XIX

Soil.	No. of Trials	Average pH.
Table Mountain sandstone mist belt	6	5.20
Table Mountain sandstone	9	5.32
Granite	2	5.79
Ecca	9	5.83
Recent Sands	7	5.78
Dwyka	4	6.00
Dolerite, basalt and Tugela schist	4	5.34
Alluvium	3	6.68

The most acid soils, as revealed in this group of experiments, are those derived from Table Mountain sandstone, in the mist belt as well as out of the mist belt area, and those derived from dolerite, basalt, and Tugela schists. In the case of Recent Sands, the results from two experiments where the pH had been raised by the application of large amounts of carbonatation filter cake, have been omitted.

FERTILIZER EFFECT ON SUCROSE.

The 5 x 5 nitrogen and potash trial already referred to under yield responses provides a fairly typical if somewhat extreme example of the effect of nitrogen and potash on sucrose per cent. cane. The sucrose results of this experiment where both nitrogen and potash gave significant increase in tons cane per acre and tons sucrose per acre, were as follows :

TABLE XX

Sucrose per cent cane.

	N0	N1	N2	N3	N4	Mean
K0	17.34	16.56	16.18	15.84	15.72	16.33
K1	16.98	18.26	17.30	16.31	16.38	17.04
K2	17.28	17.25	17.59	17.18	17.60	17.38
K3	18.08	17.45	17.66	17.66	17.10	17.59
K4	17.44	17.64	17.10	17.02	17.37	17.32
Mean	17.43	17.44	17.17	16.80	16.83	17.13

S.E. of marginal means = 0.12

S.E. of body of table = 0.27

In this experiment both N and K_2O varied from 0 to 400 lbs. per acre in steps of 100 lbs. per acre. The results show that the decrease in sucrose per cent cane due to nitrogen is very highly significant and so is the curvature in response to potash. There is, however, a highly significant interaction between nitrogen and potash. Thus the nitrogen application in the absence of potash steadily decreases the sucrose per cent cane, but the addition of potash largely restores the sucrose content resulting in excellent sucrose responses to potash at high nitrogen levels.

In quite a number of Regional Fertilizer Trials a rather similar pattern of responses was noticeable, but here of course the levels of nitrogen and potash were not as high and the picture not as complete. The averaged results are :

TABLE XXI

Treatment		Sucrose per cent cane
N1	60 lbs. N per acre	14.82
N2	120 lbs. „ „ „	14.88
N3	180 lbs. „ „ „	14.60
N4	240 lbs. „ „ „	14.50
N1	0 lbs. N per acre	15.56
N2	50 lbs. „ „ „	15.46
N3	100 lbs. „ „ „	15.31
N4	150 lbs. „ „ „	15.09
K1	0 lbs. K_2O per acre	14.95
K2	100 lbs. „ „ „	15.10
K3	200 lbs. „ „ „	15.19

The depressing effect of nitrogen on sucrose may here possibly be accentuated by the fact that responses to nitrogen were relatively small in plant cane and further that part of the N3 and N4 dressings were applied late.

The depression due to nitrogen and the increase in sucrose following potash application may well be considered relatively small but even such small changes in sucrose per cent cane may be economically all-important, particularly so where transport costs of cane are high.

The increase in sucrose content due to potash application is largely a function of potash yield response and it is quite wrong to assume, as is sometimes done, that because potash on the average increases sucrose content that it will also do so where the potash status of the crop is satisfactory. Where potash deficiency is acute the increase in sucrose per cent cane may often be much greater than here given but where abundant potash is available, no such increases can be expected and in fact the general tendency is downwards. Thus the average sucrose per cent. cane in six experiments in which the crop yields of both 100 and 200 lbs. per acre applied K_2O were somewhat depressed, although not statistically significantly so, shows a general decrease with increased potash application. The mean results for the six experiments were as follows :

TABLE XXII

Treatment.	Tons cane per acre.	Sucrose per cent cane.
0 lbs. K_2O per acre	54.43	16.58
100 lbs. „ „ „	52.60	16.52
200 lbs. „ „ „	52.18	16.33

The average exchangeable potash found in these experiments before potash application was 257 ppm. K_2O in soil and the mean leaf composition from control plots 1.40 per cent K_2O.

The depression in sucrose due to potash application can in fact reach significant levels as in the following experiment where the exchangeable potash found was 187 ppm. K_2O and with no yield response :

TABLE XXIII

Treatment.	Sucrose per cent cane.
0 lbs. K_2O per acre	16.08
100 lbs. „ „ „	15.91
200 lbs. „ „ „	15.40

Least significant difference 0.56 at 5 per cent level.

On the other hand where the crop is suffering from potash deficiency significant increases in sucrose per cent cane may be expected. Thus in an experiment where exchangeable potash averaged only 51 ppm. K_2O and excellent yield responses were obtained, the sucrose content of the cane was also significantly improved. The results were :

TABLE XXIV

Treatment.	Tons cane per acre.	Sucrose per cent cane.
0 lbs. K_2O per acre	57.14	14.87
100 lbs. „ „ „	66.10	15.32
200 lbs. „ „ „	70.14	15.51
Least significant difference at 5%	5.41	0.61
„ „ 1%	7.54	0.84

Phosphate application seldom has a marked effect on sucrose concentration, but an occasional significant depression has been noticed.

Irrigation is often considered to depress sucrose per cent cane, but with controlled irrigation and proper drying-off that should not happen and the sucrose per cent cane may well be enhanced. Thus in an experiment planned by the agronomist of a sugar company but analysed at the Experiment Station the following was found :

TABLE XXV

Treatment.		Sucrose per cent cane.
W0	No irrigation	15.81
W1	Irrigation as for estate practice	16.93
W2	Irrigation in excess of estate practice	18.25

The average increase in sucrose per cent cane due to the application was thus :

1.22 $\pm$ 0.59 at 5 per cent level.

0.79 at 1 per cent level.

The high sucrose levels here obtained and probably some of the responses shown, are due to the desiccation of the cane which was accidentally burnt by a hot fire just before harvesting, but even allowing for a common standard of 70 per cent moisture content of the cane the irrigation treatment still showed an increase in sucrose per cent cane amounting to 0.54 and 1.41 per cent compared with the actual of 1.12 and 2.44 per cent.

DETERIORATION OF CUT CANE.

During November to December 1959 an investigation was carried out at the Experiment Station to determine the deterioration of cane after cutting and to assess the extent of the sucrose losses. The main object here was to find out in how far cane cut up in approximately one foot lengths will deteriorate quicker than cane cut in the normal manner. It was thought that the Massey-Ferguson cane cutter at present being tested out in Australia may in future find a use in South Africa. This cutter chops up cane in about one foot lengths and the possibility and extent of quicker sucrose losses were therefore investigated. For this purpose the cane was divided into heaps of approximately 50 lbs. each, with half the number of heaps cut up in one foot lengths and the rest left whole. All heaps were weighed initially and control heaps of whole and cut-up cane analysed immediately. The remaining heaps were left under prevailing weather conditions in the open and re-weighed and analysed after 2, 4 and 6 days. Several commercial varieties were used in this comparison. The average results are shown in Table XXVI.

It will be seen that cane cut into one foot lengths dried out and also deteriorated more quickly than whole cane and consequently the loss of sucrose is appreciably greater in the cut up cane than in the whole cane, which was to be expected. The losses of sucrose are, however, disconcertingly high even in the whole cane and deterioration appears to set in almost immediately after the cane has been cut. The rate of deterioration increases with time. This fact is somewhat obscured in practice because desiccation of the cane tends to increase the remaining sucrose per cent cane with the result that only after six days is a noticeable fall in sucrose per cent cane evident. In fact after two days the sucrose per cent cane appears higher than at the start. This obscures the actual loss of sucrose taking place. Not only is the total amount of sucrose falling immediately after the cane has been cut, but the purity of the juice drops and because of the drying out of the cane the fibre per cent cane is increasing with the result that the availability of the sucrose is also falling. Thus if the results of the whole cane are examined (and in the case of cut up cane the same applies to an even greater extent) the picture as shown in Table XXVII emerges.

TABLE XXVI

		No. of days.			
		0	2	4	6
Per cent original weight	Whole cane	100	96.6	93.8	91.1
	1 ft. lengths	100	95.5	91.4	89.6
Sucrose per cent cane	Whole cane	13.82	14.03	13.82	13.48
	1 ft. lengths	13.82	13.94	13.76	13.59
Per cent original sucrose lost	Whole cane	0.0	2.0	6.2	10.6
	1 ft. lengths	0.0	3.8	9.0	13.8

TABLE XXVII

Whole cane samples.

	No. of days.			
	0	2	4	6
Per cent original weight	100.0	96.6	93.8	91.1
Sucrose per cent cane	13.82	14.03	13.82	13.48
Fibre per cent cane	13.59	14.11	14.13	14.53
Per cent of original sucrose lost	0.0	2.0	6.2	10.6
Average daily loss per cent	0.0	1.0	1.5	1.8
Purity of crusher juice	90.9	88.8	86.8	83.9
Approximate per cent loss of available sucrose	0.0	3.6	9.0	15.4
Approximate daily loss of available sucrose	0.0	1.8	2.3	2.6

From this table it can be seen that for every additional day on 2-4 days old cut cane the loss of available sucrose is of the order of two per cent of the total present. It is imperative therefore to get cane milled as soon as possible after cutting. It is likely, however, that losses during the cooler winter months will not be as high as these here recorded for the November-December period.

PRESENT FERTILIZER POSITION

Data supplied by the Fertilizer Traders' Association reveal that the recent tendency of increased usage of nitrogen and potash has been maintained during 1959, and as during the previous year, there is also an increase in the amount of phosphatic fertilizer used. The amount of phosphates used has fallen from 1951 when data first became available to 1957 and seems to have reached its lowest level in that year after which it increased to 1958 and has shown a further substantial increase in 1959.

The trend in fertilizer usage in recent years is shown in Table XXVIII.

The ratio of N : P_2O_5 : K_2O is therefore very close to 2 : 1 : 2. It is of interest to note Mauritius, Australia and Hawaii also use these three fertilizers in practically the same relative proportion i.e. 2 N to 1 P_2O_5 to 2 K_2O.

Nearly half the total mixtures sold last year was 10 : 6 : 10, and the second most popular mixture was 15 : 0 : 15. The most popular planting mixtures were 5 : 13 : 5 and 3 : 13 : 8. These four mixtures accounted for more than 90 per cent of the total mixtures used.

Superphosphate amounted to 68 per cent of the phosphatic fertilizer used while rock phosphates accounted for 12 per cent, basic slag 10 per cent and basic super 8 per cent.

Of the 25,879 tons of nitrogenous fertilizer used, ammonium nitrate formed 40 per cent, ammonium sulphate 30 per cent, urea 25 per cent, limestone ammonium nitrate 4 per cent. This means that approximately 42 per cent of the total nitrogen used as straight fertilizer was in the form of ammonium nitrate and 36 per cent in the form of urea.

Practically all potash used was in the form of muriate of potash.

TABLE XXVIII

	1951	1953	1955	1957	1959
Tons mixed fertilizer	25,277	19,817	37,564	23,412	33,805
,, nitrogenous fertilizer	5,280	11,882	16,495	19,381	25,879
,, phosphatic fertilizer	15,297	17,883	8,470	8,099	17,419
,, potassic fertilizer	125	2,000	3,998	8,746	15,930
Total tons N	2,135	3,327	5,856	6,875	11,324
,, ,, P_2O_5	6,526	5,725	5,183	3,415	5,980
,, ,, K_2O	842	1,712	4,564	7,389	12,721
Total tons of cane cut	4,805,249	6,221,531	8,005,990	8,594,618	9,123,396
Lbs. N per ton of cane	0.89	1.07	1.46	1.60	2.48
,, P_2O_5 ,, ,, ,, ,,	2.72	1.84	1.29	0.79	1.31
,, K_2O ,, ,, ,, ,,	0.35	0.55	1.14	1.72	2.79

Cultural Practices

Chief Agricultural Officer: C. H. O. PEARSON

The experiments now in progress are listed in Table XI. An analysis of the extensive data collected from many of these experiments has permitted a reduction in some instances of the recording programme. Thus, analysis of leaf sampling data collected at two-monthly intervals showed that leaf sampling was only of value during the summer months when the cane was in active growth. Systematic soil sampling of individual plots after each harvest has brought to notice a progressive fall in pH values in some instances, due to the application of increasing quantities of sulphate of ammonia. While there are no indications as yet that such drops in pH as have been recorded have had any effect on crop yields, the situation needs to be kept constantly under observation against such an eventuality.

Agricultural Trials.

Four trials were harvested during the year. One, comparing bare fallow, trash fallow, and green manure crop before planting, and harvested as first ratoon was terminated inconclusively on account of excessive inter-plot variations which emerged during the season. Of the remaining three, two comparing trashing with burning trash were harvested as plant cane and first ratoon respectively.

The first of these on a dolerite soil which is now in its third cycle of cropping, can now be regarded almost as a "classical experiment" with sugarcane, since it is now in its twenty-first year. Twice replanted with newer varieties, this experiment was originally laid out without randomization. Despite these disadvantages the experiment continues to yield much valuable data.

In the current crop from plant cane of the variety N : Co. 376 the effect of fertilizer has induced a significant response over no fertilizer for both tons cane and tons sucrose per acre in both burnt and trashed plots as is indicated in Tables I and II. This is in accordance with results obtained from the previous planting cycle with the variety Co. 301.

Table I

Mean Tons Cane per Acre.	Trash burnt	Trashed.	Mean.
With fertilizer (F)	61.83	62.03	61.93
No fertilizer (OF)	50.65	53.29	51.97
Mean	56.24	57.66	56.95
F — OF	11.18	8.74	9.96

SE of fertilizer mean = 1.04

L.S.D. mean F — OF = 3.15 t.c.a. at 5% level
4.38 t.c.a. at 1% level.

TABLE II

Mean tons sucrose per acre.	Trash burnt	Trashed.	Mean.
With fertilizer (F)	9.82	9.74	9.78
No fertilizer (OF)	8.14	8.56	8.35
Mean	8.98	9.15	9.06
F — OF	1.68	1.18	1.43

SE of fertilizer mean = 0.19

L.S.D. mean F — OF = 0.58 t.s.a. at 5% level
0.81 t.s.a. at 1% level.

Table III summarises the mean yields for the burnt and trashed treatments from all crops.

TABLE III

Summary of yields of two complete cycles of cane and the plant cane of the 3rd cycle.

Treatment.	Trash lined.	Trash burnt.	T-B
Planted in 1939 to Co. 281			
Plant cane harvest 1941	42.17	39.77	2.40
1st Ratoon harvest 1943	61.13	52.83	8.30
2nd Ratoon harvest 1945	49.16	40.26	8.90
3rd Ratoon harvest 1947	41.42	28.10	13.32
Ploughed-out, green manured.			
Planted 1948 to Co. 301.			
Plant cane harvest 1950	54.74	54.12	0.62
1st Ratoon harvest 1952	53.65	47.75	5.90
2nd Ratoon harvest 1954	46.41	40.02	6.39
3rd Ratoon harvest 1956	41.88	35.00	6.88
Ploughed out, green manured.			
Planted in 1957 to N : Co. 376			
Plant cane harvest 1959	57.66	56.24	1.42

It will be noted that while trashing has yielded on average an increase of approximately six tons of cane per crop, on two successive replantings which were preceeded by a fallow and green manure crop there has been a remarkable recovery in the burnt plots to the extent that differences between burnt and

unburnt plots have been virtually eliminated. This would appear to indicate that the fall-off in yield of successive ratoons in the burnt plots is in large measure due to depletion of organic matter. The situation is further complicated, however, by the fact that superphosphate has been applied to each crop as a top dressing — apart from the furrow dressings applied at planting — and it is now known that phosphate uptake is enhanced when it is applied on top of trash compared with when applied to bare ground. An outstanding feature of this experiment is that the nil fertilizer plots which have received no fertilizer for twenty-one years (and if any prior to 1939, nothing but dressings of superphosphate and filter cake) can still yield cane at 50 tons per acre.

The second trashing experiment with the variety N : C. 310 also on a dolerite soil was harvested as a first ratoon in its second cycle. This experiment was designed to test whether any benefits are to be derived from ploughing in the trash from the last crop at ploughing out, in combination with burning and trash management in ratoon crops.

In the previous crop cycle the burnt plot yields had shown a slow decline in comparison with those where trash was retained. In the present cycle no differences have so far arisen between treatments as indicated below.

Table IV

Yields from Trashing and Burning Treatments.

	20 Month Plant Cane t.c.a.	25 Month 1st Ratoon t.c.a.
A. Trash blanket		
Trash from last crop ploughed-in	70.19	52.64
B. Trash lined.		
Trash from last crop ploughed-in	68.57	53.30
Mean for ploughed-in trash	(69.38)	(52.97)
C. Trash blanket		
Trash from last crop burnt	67.61	52.28
D. Trash from all crops burnt	66.63	52.73
Mean for trash burnt	(67.12)	(52.50)

Under the conditions of these two experiments to date it would seem that while trashing should be practised during ratoon crops, the trash from the last crop could be burnt without adverse effects on the subsequent plant cane crop. Further, with the amounts of trash left from these particular crop yields, lining of the trash constituted only an additional operation and an additional expense which brought no worthwhile returns.

The fourth trash management trial was designed in an attempt to throw light on the effects of a heavy trash blanket on the yields of the subsequent ratoons and to test whether additional nitrogen would compensate for the drop in yield, if any, brought about by the extra trash. Cut as a first ratoon the experiment showed no significant response to nitrogen but significant responses to trash treatments which are summarised below.

Table V

Tons cane per acre.

Treatments.	22 months **1st Ratoons.**
No trash	64.50
7 tons trash per acre	68.65
16 tons trash per acre	68.47
25 tons trash per acre	63.15

The 25-ton-per-acre trash treatment is perhaps a little unreal when applied to a 65-ton-per-acre crop but the depression in yield is presumably brought about by suppression of regeneration, since additional nitrogen had no effect, and would therefore be independent of the size of the previous crop taken off.

The results so far suggest that while at this yield level some trash is better than none, the full amount of trash from the crop is by no means essential to obtain a worthwhile response — or alternatively and probably more correctly, to counteract the deleterious effects of removing completely all trash under the conditions of the experiment.

A previous in-line sett spacing trial conducted under dry land conditions had revealed no statistically significant differences in crop yields between treatments when continuous planting of the setts in the row was compared with three foot, five foot and seven foot spacings between setts at five foot inter-row spacing. There were indications nevertheless that a small reduction in yield could be expected from increasing the spacing between setts.

This experiment was repeated under irrigation and has now been cut as second ratoon. Results confirm those from previous crops in that a highly significant reduction in yield was brought about by increasing the spacings between setts as indicated in Table VI.

Table VI

Spacing between setts	**Tons cane per acre.**
Continuous planting	60.59
3 ft. between setts	56.99
5 ft. between setts	54.75
7 ft. between setts	46.33

These experiments indicate that while under normal dry-land conditions a germination of 50 per cent, using normal continuous stick planting methods, is unlikely to cause any substantial decrease in yield, under more favourable rainfall conditions or under irrigation a good germination of setts is essential if maximum crops are to be achieved. This subject is referred to again later in discussing the effects of germination on plant populations.

A new series of spacing trials was started in December 1959 with the planting of a trial under irrigation to three varieties (a) N : Co. 376, (b) N : Co. 334, and (c) N. 50/211, with three rates of fertilizer, (a) Nil, (b) 200 lbs. N, 150 lbs. P_2O_5 and 200 lbs. K_2O, and (c) 400 lbs. N, 300 lbs. P_2O_5 and 400 lbs. K_2O, and all the above treatments planted to inter-row spacings of (a) 1 ft. 6 ins. between rows, (b) 3 ft. between rows and (c) 4 ft. 6 ins. between rows.

A count of shoots taken seven weeks after planting showed that there was a difference between the numbers of shoots produced by the different varieties, that fertilizer rates had had no effect at that stage on the numbers of shoots and that close row spacing at 1 ft. 6 ins. resulted in more shoots per line than the wider row spacings.

Table VII

Mean number of shoots per line according to inter-row width.

1 ft. 6 in. inter-rows	41.6 shoots
3 ft. inter-rows	34.5 shoots
4 ft. 6 in. inter-rows	31.4 shoots.

At first this effect was attributed to grazing by hares, as it was noted that many young shoots were being nibbled off at ground level, especially in the variety N : Co. 376. However, in further spacing plots planted in March at Mount Edgecombe which were protected by a fence somewhat similar results were obtained as shown in Table VIII.

Table VIII

Percentage Germination of Eyes.

	Variety.	
Inter-row width	**N.50/211**	**N : Co.376**
1 ft. 6 in.	78.1%	71.0%
3 ft.	67.4%	72.3%
4 ft. 6 in.	66.9%	66.1%

In this trial three types of sett were used to test the possibilities of establishing more uniform plant populations in experimental plots. The three types were as follows :

(a) Single-eyed setts pre-germinated between wet sacks.

(b) Single-eyed setts prepared from canes which had been topped 9 days prior to cutting for seed.

(c) Standard 4-eyed setts.

All types were treated in a "combined" mercurial/insecticidal dip at the time of preparation.

Highly significant differences were obtained in the germination percentage as is shown in Table IX.

Table IX

The percentage germination according to type of sett.

	Variety	
Type of sett.	**N.50/211**	**N : Co.376**
Single eyed pre-germinated	79.9	61.3
Single eyed prepared	72.6	81.3
Four budded orthodox	49.0	68.2

The failure of the N : Co. 376 pre-germinated setts appeared to be due to the sett roots forming before the eye swelled, so that at transference from the wet bagged tray to the furrow, the rootlets were damaged. The N.50/211 produced swollen eyes before the sett rootlets and the highest germination was obtained by this treatment.

The extremely low percentage germination of eyes from the four budded setts in the N.50/211 is not unusual under ordinary field conditions and will give an acceptable commercial stand of cane although as has already been indicated, under favourable conditions of moisture optimum yields will not be obtained. For experimental purposes however, it may well be necessary to prepare setts before planting so as to establish a more uniform population of plants per plot.

These two trials were planted in furrows only four inches deep, with the soil drawn over the setts and left flat. The decision to plant in this way was arrived at as a result of a furrowing experiment at the Mtunzini Propagation farm where planting furrows were made with two types of furrowing ploughs at from (a) 8 in. to 14 in. depth and (b) 4 in. depth. The furrowing ploughs were (1) chisel pointed, (2) flat duck foot pointed.

The results from a lifted two feet length of row from each row throughout the experiment are given in the table below :

TABLE X

	Percentage germination		Mean No. of shoots per plot	
Furrow Depth	8"-14"	4"	8"-14"	4"
Chisel pointed	43.3	50.0	48.8	64.0
Duck foot pointed	59.6	56.3	69.5	72.5
Mean for the plots	51.4	53.1	59.1	68.2

Thus the duck foot pointed ridger seemed to give a better germination presumably due to better soil/sett contact, while the 4 in. depth of planting gave better tillering. In this instance one inch of rain fell the night the experiment was planted whilst the March plant at Mount Edgecombe was done under extremely dry conditions. In both these instances and in the spacing trial at Chaka's Kraal the four inch depth of furrow proved very satisfactory.

Environment Stations and New Canes.

Four of the five environment stations for the growing of new seedlings were selected and started during the year, these being on :

Coastal sands at Tongaat Sugar Co., Ltd.

Table Mountain sandstone at Gorge Estate, Illovo Sugar Estates, Ltd.

Alluvium at the Umhlatuzi Valley Crown Lands.

Irrigated land at the Chaka's Kraal Experimental Farm.

In each of these some 500 selected varieties were planted as single stools, two four-budded setts being planted as one stool.

The site of the remaining station on granite soil has still to be selected.

The sequence of breeding plots and trials was continued at the Mtunzini Propagation Farm and the variety N.50/211 was distributed for the first time in 1959. The growth of this cane under extremely dry conditions was excellent, and averaged 32 tons per acre as 13 and 15 month old cane.

Trials established during the year.

Besides the above environment stations the following trials were planted :

On South African Sugar Association Stations :	
Variety trials	8
Cultural practices trials	6
On Co-operators' lands :	
Variety trials	2
Diseases and pests control trials	4
Spacing trials	2
Fertilizer trials	1

The total number of trials now stands at 161, distributed as in Table XI.

TABLE XI

TRIALS IN EXISTENCE IN THE CANE BELT DURING 1959 - 1960.

TYPE OF TRIAL	R.F.T.		Exploratory Fert.		Fertilizer		Agronomic		Variety		Irrigated		Disease		Number of Trials		GRAND TOTAL
	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	
Zululand	5	14	4	2	2		2		2	2			6	1	21	19	40
North Coast	11	4		2	2	1		1	3	3			6	1	22	12	34 *
South Coast	5	3	1	2		1			2	3			1		9	9	18
Mtunzini Propagation Farm							2		5	3					7	3	10
Chaka's Kraal Experimental Farm			2		5	2	3	3	1	4		4		2	11	15	26 *
Mount Edgecombe Experiment Station							1	2						16	1	18	19 *
Outside S.A.S.A. Observers	3		2	1						3		2			5	6	11
Environment Sites																	
Tongaat Sugar Co. Ltd.									1								1 *
Umhlatuzi Valley Sugar Company, Ltd.									2								2 *
Illovo Sugar Estate, Powerscourt																	Nil *
Chaka's Kraal Experimental Farm																	Nil *

* Plus seedlings — single lines and propagation plots.

Total number of trials : 161

Cane Varieties

Plant Breeder: P. G. C. BRETT

THE PRESENT VARIETY POSITION.

The varietal composition of the cane crop during the last five years showed the following trends. N : Co. 310 continued as the major variety, supplying between 55 and 60 per cent of the total crop; the other N : Co. varieties increased slowly; and the Co. varieties declined. It appears that N : Co. 310 has now passed its peak, and, in the ordinary course of events, an increasingly rapid decline in popularity could be expected during the next few years. However, it is possible that heat-treatment and careful selection of seed cane may succeed in prolonging the life of this extremely valuable variety.

With Co. 301 on the point of disappearance, Co. 331 declining, and N : Co. 310 probably starting on a downward trend, it is interesting to speculate on what varieties are likely to take their places. Neither of the N : Co. varieties released in 1952 — N : Co. 293 and N : Co. 339 — has shown a tendency to increase rapidly. The popularity of N : Co. 293 is likely to remain limited because of its three chief weaknesses — its susceptibility to smut disease, its tendency to flower profusely, and its inability to ratoon well under adverse conditions. N : Co. 339, though a high-yielding variety, suffers from the grave disadvantage of being extremely susceptible to mosaic and tending to spread this disease to other varieties—this dangerous weakness should limit its popularity. N : Co. 292 released in 1954, does not flower freely, and has shown fairly good resistance to most diseases; however, it is not particularly vigorous, even when conditions are in its favour. It is, therefore unlikely to achieve any great popularity.

It may be concluded that of N : Co. 292, N : Co. 293 and N : Co. 339 none is ever likely to become a major variety, capable of taking the place of those at present in decline. For such replacements we must look to the more recently distributed varieties.

N : Co. 376, distributed only in 1955, had by last season already come to form 6.6 per cent. of the total crop. This high yielding variety, adapted to a wide range of conditions, appears capable of one day taking its place as the major variety of the Industry. It is disturbing, therefore, to find that in some areas, particularly on the South Coast, N : Co. 376 is becoming heavily infected with mosaic disease. It would be most unfortunate if this potentially valuable variety were lost to the Industry, and everything possible should be done, therefore, to maintain it in a healthy condition.

N : Co. 334, distributed in 1957, may come to occupy certain specialized areas in the cane-belt, particularly those where wet conditions prevail, but its extreme susceptibility to ratoon stunting disease and to drought, almost certainly preclude it from ever making an important contribution to the total crop. N : Co. 382, distributed at the same time as N : Co. 334, is likely to prove the much more valuable variety. It is a very hardy variety and can give reasonable yields under extreme conditions, such as are found on the very poor coastal sands, where N : Co. 376 has been found to fail.

It may be concluded that the varieties likely to expand most rapidly in the near future are N : Co. 376 and N : Co. 382. The introduction of restrictions on production, however, may retard the normal rate of change in the varietal position, because crops are likely to be ratooned a greater number of times. Restriction may also have its effect upon the relative popularity of varities. Generally speaking, stand-over crops are particularly susceptible to fungal diseases of the stem, such as red rot, and a variety that has adequate resistance under normal conditions may prove susceptible when allowed to grow for more than two years.

DISTRIBUTION OF NEW VARIETIES.

During the past season a first distribution was made of the variety N.50/211, derived as a seedling from the cross P.O.J. 2725 x Co. 285. This is the first time in the history of the Industry that a variety bred and selected under local conditions has been distributed for commercial cultivation. N.50/211 had before its release given good yields in a number of trials, and as far as can be judged in the short period since its release it appears to be showing promise in most places. It is probably the most resistant of all present commercial varieties to the diseases of smut and mosaic. Nevertheless, it is not immune, and certainly should not be needlessly exposed to heavy sources of infection.

VARIETY TRIAL RESULTS.

N.50 Series.

Two trials with seedlings of the N.50 series were harvested during the year—one at Chaka's Kraal as second ratoon, and one at Doornkop as first ratoon. For each seedling, the mean yield in terms of sucrose per acre — for all crops — has been expressed as a percentage of that of N : Co.310 for the Chaka's Kraal trial, and of that of N : Co.376 for the Doornkop trial, and these results are shown in the following table.

Variety	Chaka's Kraal	Doornkop.
Co.331	94.1	—
N.10	91.3	68.3
N.50/93	89.1	104.6
N.50/123	98.1	86.4
N.50/211	98.0	94.2
N : Co. 293	—	98.0

The variety N.10 — one of the four varieties intended for pre-release trials in the coming season — had its mean yield reduced in the Chaka's Kraal trial because of an indifferent performance in the plant cane crop; however, this may have resulted from a set-back suffered by the seed cane during heat-treatment. The newly released variety N.50/211, in the same trial yielded practically as well as N : Co. 310, and better than Co. 331.

In the Doornkop trial N.10 has shown very little promise. N. 50/211, however, has given fair results, and its present appearance, in second ratoons, suggests that when this crop comes to be taken into account, its mean yield will be appreciably raised.

N.52 Series.

Five trials with seedlings of the N.52 Series were harvested during the year, one on the main coastal belt as first ratoon — here the mean of both crops is taken — and the remainder as plant cane. The results are given below in terms of tons sucrose per acre as a percentage of that of N : Co. 376, except in the case of the Mist belt trial where the comparison is based upon tons cane per acre.

	SOIL TYPE				
Variety	Dwyka Conglomerate	Coastal Sands	Alluvium	T.M.S. Mist belt	T.M.S. Ordinary
N.52/10	71.8	66.6	73.1	93.4	80.9
N.52/115	69.5	66.4	66.2	79.2	71.7
N.52/214	79.0	45.4	68.9	90.6	82.7
N.52/219	77.8	81.4	90.7	78.0	74.4
N.52/338	67.4	63.4	82.6	56.7	74.4
N.52/340	86.5	70.0	72.5	61.8	64.3
N.50/177	—	61.0	62.0	93.2	74.6
N:Co.292	—	78.5	—	—	75.4
N:Co.293	—	—	—	116.7	—
N:Co.310	80.6	—	83.5	—	—

From the above results it appears that seedlings capable of yielding as well as N : Co. 292 — or even N : Co. 310 — are not unduly difficult to find, but the very high standard of performance set by N : Co. 376 is proving difficult to match. Even N. 52/219 — one of the varieties intended for pre-release trials — did not match the yield of N : Co. 376 in these particular trials.

N.54 Series.

One trial — a plant cane crop — was harvested with seedlings of the N.54 series. The particular seedlings tried here had been grown and selected from the earliest stages on coastal sands — in an attempt to find varieties particularly suited to these conditions. This may well be the reason why the general level of seedling performance, relative both to N : Co. 376 and to N : Co. 292, is considerably higher than in the trials previously considered. The mean yield of sucrose per acre, as a percentage of that of N : Co. 376, is given below for the different seedlings :

N.54/489	97.4
N.54/494	76.4
N.54/496	113.3
N.54/501	70.5
N.54/506	69.5
N.54/509	81.9
N.54/513	88.6
N.54/517	71.6
N.54/529	63.2
N.54/533	100.5
N.54/538	63.2
N.54/548	92.5
N:Co.292	79.0

SEEDLINGS PLANTED INTO VARIETY TRIALS.

Seedlings of the N.53 Series were planted in a replicated plot trial on an alluvium soil, and re-planted in a trial on coastal sands. Four C.B. varieties and 58 seedlings of the N.54 Series were re-planted in a replicated plot trial at the Mtunzini Propagation Farm, and 79 of the N.55 Series in a two-plot trial. Seven seedlings of the N.56 Series were planted in a primary trial at the Propagation Farm, and another seven on coastal sands. Of the N.57 Series, 98 were planted in a two-plot trial, 15 were planted in a primary trial under irrigation, and 18 under dryland conditions.

Seventy-one introduced varieties were planted in micro-plots on the alluvium environment station.

THE EARLIER STAGES OF SELECTION.

The year 1959 was marked by the establishment of environment stations and the beginning of a new selection procedure. Seedlings were selected at a year old from single stools grown at the Experiment Station, tested for Brix, and after those with a low Brix content had been discarded, the remainder were planted as micro-lines on the environment stations. The numbers planted at the different stations were as follows :

Mist belt, 528; coastal sands, 630; alluvium 526; irrigated conditions, 500. Hence, in all, 2,184 seedlings were planted as micro-lines; these were selected from a total of 20,872 single stools.

All single line seedlings of the N.58 Series were harvested, weighed and analysed for sucrose content. This group consisted of 285 seedlings grown under irrigation and 2,060 grown under dryland conditions.

In all 1,370 seedlings were planted as single lines, 24 of which had been selected from bunch stools. Nearly 200 of these seedlings had been grown under irrigation and were selected for adaption to these conditions.

The parentage of all seedlings planted in single lines and micro-lines is given in Appendix I.

SEEDLING RAISING.

During the last season a total of 39,323 seedlings from 138 different crosses were planted at the Experiment Station, the majority of them being planted at 3-foot spacing.

The 1959 crossing season proved a fairly satisfactory one, a total of 156 crosses, involving 413 female tassels, being made. From the seed thus obtained, about 50,000 seedlings were germinated at the beginning of 1960, and about 47,800 of these have been potted individually and another 600 in bunches. There still remains a reserve of seed — from 193 tassels — and this is being stored in the deep freeze.

Relatively little damping-off occurred amongst seedlings raised this year. In preliminary experiments, the proprietary fungicide Mersil — which contains mercuric chloride as its active ingredient — showed promise of preventing the spread of damping-off far more effectively than either the Cheshunt compound or potassium permanganate solution used in the past.

SPECIAL EXPERIMENTS.

The artificial induction of flowering.

In an experiment started on January 5, 1959, marcotted shoots were exposed to the following treatments :

Treatment 1. A daylength of 12¼ hours (a) from the start of the experiment, and (b), after one month's exposure to natural daylengths from the time the shoots had been marcotted.

Treatment 2. A daylength of 12½ hours — (a) and (b) as above.

Treatment 3. A daylength of 12¾ hours — (a) and (b) as above.

Treatment 4. A daylength of 12½ hours — (a) and (b) as above — and, in addition, 0.5 ccs of a 100 parts per million gibberellic acid solution were placed in the spindles at monthly intervals.

Five shoots each of the varieties Co.213, Co.331, Co.421, N : Co.310 and N : Co.334 were subjected to each of the above treatments. Five shoots each of the varieties Co.214, Co.290, Kassoer, M.165/38 and P.O.J.2878 were subjected to treatments 1a, 2a and 3a only.

Initiation of flowering was induced only under a daylength of 12½ hours, none at all occurring under the other treatments. The number of shoots in which initiation occurred — not necessarily followed by the emergence of inflorescences — for the first group of varieties was as follows : Treatment 1a, 22; treatment 1b, 22; treatment 4a, 18; treatment 4b, 13.

It appears therefore that on this occasion, gibberellic acid had if anything an adverse effect upon floral initiation. Initiation was delayed in the (b) treatments as compared with the (a), indicating that the shoots, in spite of the possible injurious conditions to which they had been subjected while being marcotted, were receptive from the start of the experiment to induction under favourable daylengths.

Under treatment 2, floral initiation was induced in at least some of the shoots of all varieties except Kassoer.

In the above experiment the cut shoots were first marcotted, while being kept in the sulphurous acid — phosphoric acid preserving solution, and then transplanted to large boxes. A new method is now being adopted whereby the shoots are directly rooted in boxes without any intermediate stage involving the use of a preserving solution. This is accomplished by first trimming the leaves and then covering the tops of the shoots with polythene tubing. Transpiration is greatly reduced and the shoots are able to survive and establish themselves on their new root systems without provision being made for any special water supply.

The artificial induction of pollen fertility.

In an attempt to reduce the mortality which occurs amongst embryonic inflorescences when they are subjected to the artificial conditions necessary to induce pollen fertility, all water used for making solutions last season was first passed through a Katadyn filter and then through a de-ioniser. In addition, the painted metal troughs previously used for solution were replaced by plastic ones. It is thought probably that these measures were at least partly responsible for the lowered mortality which occurred last season.

Preliminary experiments had previously suggested that in Natal night temperatures alone are limiting for pollen fertility, day temperatures being sufficiently high to permit proper pollen development. Last season a large number of comparisons were made — using at different times different varieties — between shoots kept permanently in the glasshouse in the normal way and shoots moved outside during the day. The latter were kept in a heated building, normally used for photoperiod work, during the night. The general appearance of the shoots moved outside during the day was healthier than that of the glasshouse shoots; however, there appeared to be no differences in the mortality rate, and inflorescences in the glasshouse not only developed more rapidly but their pollen fertility was generally better.

Of 240 flowering shoots kept in the glasshouse, 89 died, and 16 showed no dehiscence of their anthers; of the remainder, 55 showed very good dehiscence. The corresponding figures for 223 flowering shoots moved outside during the day were, 89, 17 and 29 — that is to say, though comparable in other respects, only about half as many of the shoots moved outside during the day showed very good dehiscence.

It remains to be seen whether, if the shoots are moved outside during the warmest part of the day only, it will be possible to induce a high degree of pollen fertility.

A COMPARISON OF SEEDLINGS FROM DIFFERENT CROSSES.

An experiment comparing plots of unselected single stool seedlings with plots of a standard variety was harvested during the year. Each seedling plot consisted of four rows, each row with ten unselected seedlings. The seedlings were planted at the usual spacing for single stools — 3 feet apart in rows spaced alternately 4½ and 9 feet apart. For the standard variety, the planting was continuous in the rows but the spacing between rows was the same as that for seedlings.

The experiment as a whole consisted of five different crosses and the standard variety N : Co. 376. Six replications were used — hence a total of 240 seedlings for each cross was planted. Selection of the seedlings was made in the usual way, and the plots were then harvested and weighed. The results obtained are given at the bottom of this page.

It will be seen that there appears to be some correlation between the mean weights per plot and the intensity of selection. This suggests that the mean yield of a cross may provide a fairly reliable indication of its value, even though variability is ignored. Of the five crosses, the three previously considered outstanding gave the highest mean yield per plot; next in order was a cross considered to be fair and the last was one considered below average.

Although the yields obtained from seedlings were in all cases significantly inferior to the yield of N : Co. 376, they nevertheless appear surprisingly high for original, unselected, seedlings — the more so as they had been spaced three feet apart in their rows. It is also surprising that the coefficient of variability was not found to be greater for the seedling plots than for N : Co. 376. It would seem that in a good cross a large number of seedlings may closely approach the yielding ability of commercial varieties and also that the marked variations in vigour commonly observed between single stools in the field may be due far more to environmental factors than to genetic factors, than is generally realised.

The low coefficient of variability for the seedling plots suggests that use might be made of original, unselected, seedlings of a particular cross — repeated as required — to provide some sort of absolute standard against which any deterioration in a commercial variety could be measured.

Cross No.	Parentage (or variety)	Mean weight per plot in lbs.	S.E. as % of mean	Total number of seedlings selected
—	N : Co. 376	1861	12.33	—
4M	Co. 421 x Co. 331	1540	5.73	30
72N	Co. 421 x Co. 312	1539	12.88	9
41N	N : Co. 310 x Co. 331	1408	5.43	14
7M	N : Co. 339 x Co. 301	1181	12.71	7
9M	N : Co. 293 x Co. 312	1063	8.73	1

Cane Diseases

Plant Pathologist: G. M. THOMSON

Over the past year the accent has been on the incidence of mosaic disease in the Industry and on ratoon stunting disease and its associated problems.

MOSAIC DISEASE.

1. Mosaic in N : Co. 376.

The mosaic situation has caused some concern in the Industry over the past year particularly in regard to increasing incidence in the variety N : Co. 376.

This variety has in the past been classed as fairly resistant to mosaic, but recently the picture has changed somewhat, and in certain areas its resistance appears to have decreased. The situation is made more serious by the fact that the variety is by no means tolerant of the disease, the usual effect being a severe stunting of infected plants.

To determine the incidence of mosaic in N : Co. 376 and other varieties, a survey was carried out on the South Coast including the inland Umzinto-Dumisa region known in the past for a high mosaic incidence. It was apparent from the results of the survey that one of the contributory factors in the breakdown of resistance in N : Co. 376 is the continued cultivation of the mosaic-susceptible but tolerant variety N : Co. 339, which acts as a source of infection for surrounding cane.

A further possibility exists in that a new strain of the mosaic virus may be responsible for the increasing incidence of the disease in N : Co. 376.

2. Strains of the Mosaic Virus.

The existence of more than one strain of the mosaic virus in Natal has long been suspected and work in this sphere constitutes a long-term project.

A visit to a farm in the Upper Tongaat threw doubt on to the matter of mosaic tolerance in N : Co. 339. Inspection of the field concerned showed a practically 100 per cent infection with some of the stools showing signs of stunting which could not at the time be attributed to ratoon stunting disease. The possibility thus exists of the presence of a new virulent strain of the virus to which N : Co. 339 is intolerant.

Further work on the strains of the mosaic virus has consisted of the collection of mosaic samples from different parts of the Industry and the screening of varieties in an attempt to find one which will prove useful in the separation of strains. In this latter respect P.O.J.36 is showing some promise at present.

3. Mosaic Resistance Trial — N.55/— Series Seedlings.

Observations made on this experiment during the first eight months of the plant cane crop showed a satisfactory spread of the disease from the inoculated maize to the test varieties and controls. The incidence of the insect vector has been at a satisfactory level this year.

The degree of infection in the exotic and commercial varieties is shown in the following table.

Table 1.

Incidence of Mosaic in Resistance Trial

(8 months Plant cane)

Variety	No. stools infected (24 planted)	% Infection
Co.360	2	8.3
Co.462	—	—
Co.617	—	—
M.165/38	—	—
M.423/41	10	41.7
C.B.36/14	—	—
C.B.38/22	—	—
C.B.45/27	7	29.2
C.B.38/39	—	—
Q.50	6	25.0
N : Co.292	1	4.2
N : Co.310	1	4.2
N : Co.334	3	12.5
N : Co.339	16	66.7
N : Co.376	6	25.0
N : Co.382	—	—

Although a final assessment will not be made without ratoon observations it is apparent that the level of resistance in N : Co. 376 is lower than normal as compared with the known high susceptibility of N : Co. 339.

RATOON STUNTING DISEASE.

The need for more action in the control of the disease on the part of planters was emphasized during the past year by the apparent effect of drought conditions on infected cane in various parts of the Industry.

A number of enquiries were received regarding poor ratooning in fields which had been cut last spring and in which the ratoon cane was severely retarded. In some cases gaps were evident in which ratooning had failed completely.

It is re-assuring to note that an increasing interest in the ratoon stunting problem is being taken by the various miller-cum-planter companies but more co-operation between these companies and their planters with regard to heat treatment of seed cane would be of great benefit to all concerned.

The Experiment Station is drawing up specifications for hot water treatment tanks based on experience gained with the Mtunzini Propagation Farm tanks and will in due course be in a position to supply plans of such tanks applicable to steam or electrical heating.

Further experimental work is to be carried out on the system of hot air treatment as a cure for ratoon stunting disease. In general the hot water method seems likely to be more practical and economic under Natal conditions.

1. Symptomatology.

The difficulties encountered with the diagnosis of ratoon stunting disease are well known and a method whereby early detection of the disease could be ensured would be a valuable step forward.

The "growing point" symptoms evidenced by a salmon pink discoloration in the vicinity of the growing points of very young diseased shoots has not been consistently observed in Natal in the past. However, this symptom was clearly observed in the greenhouse when water was withheld from tins of diseased canes, notably in the varieties N : Co. 334 and C.P. 36/105. Parallel cases in drought-affected cane were observed in the field during the year the symptoms being particularly clear in N : Co. 292, N : Co. 376 and N : Co. 382.

2. The Effects of Hot Water Treatment on the germination of whole sticks and setts.

In this experiment the two varieties used were Co. 331 and N : Co. 310, the seed cane in both being 12 months old. For the "whole sticks" plots all the stalks were cut to consist of 12 buds each and the seed for the "setts" was cut into 3-budded lengths. Half the cane was treated for two hours in water at 50°C and the other half was untreated.

Germination counts were made at regular intervals and the whole experiment was lifted after six weeks when a final germination count was made to exclude any secondary shoots.

In the Co. 331 "whole stick" plots the top buds germinated better than the middle or bottom buds especially in the case of untreated cane. This effect was not so obvious in the cane treated with hot water.

In the N : Co. 310 "whole stick" plots better germination was observed in the upper two-thirds of the stalk. This applied to both treatments.

The germination counts showed that with Co. 331, hot water treatment has a definite adverse effect on germination, the mean difference between treated and untreated cane being 27 per cent. This adverse effect is far more marked for whole sticks than for setts.

In the case of N : Co. 310 hot water treatment depressed germination though not nearly to the same extent as in Co. 331, the mean difference being 8.5 per cent. For whole sticks the difference fell just short of significance while for setts the difference was highly significant.

3. Ratoon Stunting Disease Yield Trials.

(a) Ratoon Stunting Disease Tolerance Trial — N.50/- Series Seedlings.

Included in this experiment are two commercial varieties N : Co. 293 and N : Co. 382 and the recently released variety N.50/211. Three crops have now been harvested from the experiment and the yields are given in table 2.

Table 2.

Ratoon Stunting Disease Tolerance Trial — N50/- Series Seedlings.

Variety		Healthy	Diseased	Decrease
N.50/93	Plant (25 months)	60.09	55.19	4.90
	1st Ratoon (12 months)	42.93	39.30	3.63
	2nd Ratoon (19 „)	51.33	50.90	0.43
N.50/123	Plant	52.68	51.20	1.48
	1st Ratoon	38.87	36.55	2.32
	2nd Ratoon	49.77	46.25	3.52

Variety		Healthy	Diseased	Decrease
N.50/211	Plant	63.80	67.75	– 3.95
	1st Ratoon	42.22	35.70	6.52
	2nd Ratoon	54.15	46.87	7.28
N.10	Plant	56.44	59.39	– 2.95
	1st Ratoon	34.25	36.93	– 2.68
	2nd Ratoon	50.50	48.57	1.93
N:Co.293	Plant	63.18	55.20	7.98
	1st Ratoon	33.00	21.32	11.68
	2nd Ratoon	49.13	40.60	8.53
N:Co.382	Plant	61.29	56.24	5.05
	1st Ratoon	41.45	32.30	9.15
	2nd Ratoon	53.80	45.15	8.65

Least significant difference. 1st Ratoon 5.19 @ 5% 2nd Ratoon 5.23 @ 5%
7.11 @ 1% 7.17 @ 1%

In the plant cane crop no significant effects on yield due to the disease were apparent in any of the varieties. In the first ratoon crop however the yield depressing effect of the disease was significant in the case of N.50/211 and highly significant in N : Co. 293 and N : Co. 382.

A similar picture is obvious in the most recent crop harvested. The varieties N : Co. 293 and N : Co. 382 again showed a highly significant decrease in yield in the diseased cane while in N.50/211 the effect became highly significant.

(b) The Effects of Ratoon Stunting Disease on Cane Planted in Different Soil Types.

Two of a series of experiments planted in 1955 in order to determine the effects of ratoon stunting disease on cane planted in various soil types were harvested during the year as first ratoon crops.

(1) Experiment planted on Table Mountain sandstone.

This experiment situated at Doornkop was harvested as 18-month-old first ratoon in July, 1959 and the general picture has changed considerably in three of the four varieties. The results for both crops are shown in Table 3 below.

Table 3.
Ratoon Stunting Disease trial on Table Mountain sandstone.

Tons Cane per Acre.

		Healthy	Diseased	Decrease
Co.331	Plant (26 months)	37.85	35.60	2.25
	R1 (18 months)	44.59	39.24	5.35
N:Co.310	Plant	59.94	53.77	6.17
	1st Ratoon	55.50	38.50	17.00
N:Co.334	Plant	71.26	49.85	21.41
	1st Ratoon	60.23	49.55	10.68
N:Co.376	Plant	61.21	61.81	– 0.60
	1st Ratoon	63.53	45.84	17.69

Least significant difference for treatments within a variety. Plant cane : 12.78 @ 5%
17.91 @ 1%
1st Ratoon : 12.35 @ 5%
17.31 @ 1%

Table 4.
Ratoon Stunting Disease Trial on Shale Soil.
Tons Cane per Acre.

		Healthy	Diseased	Decrease (H-D)
Co.331	Plant (24 months)	29.35	19.54	9.81
	1st Ratoon (22 months)	35.16	23.31	11.85
N:Co.310	Plant	29.56	21.71	7.85
	1st Ratoon	49.24	29.59	19.65
N:Co.334	Plant	32.90	23.04	9.86
	1st Ratoon	31.75	15.35	16.40
N:Co.376	Plant	29.21	22.27	6.94
	1st Ratoon	31.34	12.03	19.31

Least significant difference for treatments within a variety. Plant cane : 5.75 @ 5%, 8.07 @ 1%. 1st Ratoon : 10.73 @ 5%, 15.04 @ 1%

In the plant cane crop only N : Co. 334 showed a significant decrease in yield in the diseased plots as compared with the healthy. In the first ratoon however, the difference in this variety does not reach significance due possibly to contamination of the healthy plots. Two other varieties have now shown significant differences viz. N : Co. 310 and N : Co. 376. The difference in the latter variety is now highly significant.

(2) Experiment planted in Ecca shale.

The general vigour of the cane in this experiment continues to be very poor, the situation having been aggravated particularly in the diseased plots by drought conditions.

The results of both crops are given in Table 4.

In the plant cane crop the decrease in yield due to the disease was significant in all four varieties. In the first ratoon the decreases have more than doubled in two of the varieties viz. N : Co. 310 and N : Co. 376.

In the ratoon crop there was a significant increase in the fibre per cent cane in the disease plots.

(c) Ratoon Stunting Disease/Fertilizer Level Experiments.

Two experiments under dryland and irrigated conditions respectively were planted at the Chaka's Kraal Farm in 1955 to determine the effects of ratoon stunting disease when using two levels of fertilizer. The fertilizer applications were as follows :

		High Level (HL)	Low Level (LL)
At planting :	Superphosphate	750 lbs.	250 lbs.
	Muriate of Potash	100 „	0 „
Top Dressing :	Sulphate of Ammonia	500 „	100 „
	Muriate of Potash	234 „	100 „
Ratoon T.D. :	Sulphate of Ammonia	500 „ (split)	200 „
	Muriate of Potash	250 „	100 „

The dryland experiment has now been harvested as first ratoon, while three crops have been harvested from the irrigated experiment. The yields from these experiments are shown in Table 5 and 6.

Table 5.
Ratoon Stunting Disease/Fertilizer Level Experiment (Dryland)
Tons Cane per Acre

	Healthy		Diseased		Decrease (H – D)	
	Plant (23 months)	1st Ratoon (23 months)	Plant	1st Ratoon	Plant	1st Ratoon
High Level	71.61	44.25	62.04	41.78	9.57	2.47
Low Level	65.05	41.76	52.38	37.14	12.67	4.62
Decrease (HL – LL)	6.56	2.49	9.66	4.64		

Least significant difference. Plant Cane : 4.61 @ 5%, 6.32 @ 1%. 1st Ratoon : 4.20 @ 5%, 5.75 @ 1%

Table 6.

Ratoon Stunting Disease/Fertilizer Level Experiment (Irrigated)

Tons Cane per Acre.

	Healthy			Diseased			Decrease (H-D)		
	Plant 12 months	1st Ratoon 20 months	2nd Ratoon 18 months	Plant	1st Ratoon	2nd Ratoon	Plant	1st Ratoon	2nd Ratoon
High Level	75.21	77.67	38.91	60.48	64.80	28.22	14.73	12.87	10.69
Low Level	64.52	65.79	30.15	62.03	58.17	26.17	2.49	7.62	3.98
Decrease (HL – LL)	10.69	11.88	8.76	–1.55	6.63	2.05			

Least significant difference. Plant cane : 11.37 @ 5%, 15.57 @ 1% 1st Ratoon : 6.96 @ 5%, 9.54 @ 1% 2nd Ratoon : 4.85 @ 5%, 6.65 @ 1%

The decrease in yield due to the disease at the higher level of fertilizer was not significant in the first ratoon crop of the dry-land experiment whereas in the previous crop the decrease was highly significant. At the lower fertilizer level the effects of the disease were still significant. A comparison between the yields at the two fertilizer levels shows that the decrease at the lower level is no longer significant in the healthy cane but is still significant in the infected cane.

In the irrigated experiment the effects of the disease at the higher level of fertilizer are still highly significant but not at the lower level. In the healthy cane the difference in yield between the high and low fertilizer levels is still highly significant, whereas in the diseased cane there is no significant difference.

Microbiology

Microbiologist: J. R. ANDERSON

In 1959, the results of a series of experiments on nitrification and denitrification were published (Anderson 1959) which indicated that, under South African conditions, a considerable amount of nitrogen could be lost from nitrogenous fertilizers. The work was conducted on a heavy clay and a light sandy soil common to the Sugar Industry. The indication was that under conditions of low buffering ability and particularly where the C : N ratio was low, denitrification was pronounced for certain nitrogenous forms applied. This work has since been expanded to include other soil groups and nitrogen forms, but the basic interpretation regarding the losses on poor sands of low C:N ratio remain confirmed.

Whereas the preliminary probe incorporated artificially simulated conditions, the present series deals with the soil in a more natural state.

The processes and end-results of these processes are primarily aimed at aiding the nutrition section's knowledge of the biological factors involved in "unaccountable" discrepancies between nitrogen applied to the crop and nitrogen found in the crop at various stages in its growth. This will entail research into the formation of nitrates from ammonia, the formation of ammonia from nitrates, the conversion of nitrate to nitrite and gaseous nitrogen products which are lost to the atmosphere.

Urea-nitrogen is a particular study being undertaken at present with a view to determining biological conversions of urea to ammonia and the significance of reports that urea is rapidly lost from soils to which it is applied. Indications are, that for at least one soil type under various moisture and pH conditions, urea is not lost in any great quantity as ammonia gas, but the fate of the ammonia-fraction in other forms has yet to be investigated.

NEMATODE STUDIES

During 1959 nematode infestations came to light in many parts of the Industry. Assistance was given to the entomologist in this respect by investigating possible methods of enumeration of nematodes in soil samples. Various methods were explored including the flotation method,

variations of which are still regarded as the most satisfactory. One method devised at this station was the use of Whatman Extraction Thimbles (22 x 80 m.m.) placed in a known quantity of soil contained in a beaker. The thimble and soil were brought to maximum water holding capacity after which tomato root extract (5 grams chopped root in 100 mls. water, infused at 50°C for 1 hour) was introduced into the thimble, and the beaker incubated at 30°C for 4 days. On removal of the root extract from the thimble, it was found that nematodes abounded in the fluid.

The species and type of nematode could not be determined with any certainty but it was noticed that free-living nematodes were in excess of the parasitic forms, and the presence of the latter forms was inconsistent to a great extent between replications. This inconsistency in counts has for the meantime eliminated the technique as one from which soil enumerations can be made, but is regarded as being of some use from a qualitative aspect. Thus far, 30°C has been found to be the optimum incubation temperature at which the nematodes migrate into the thimble. Incubation at 4°C, 10°C and 50°C gave counts inferior to those obtained at 25°C, 30°C and 35°C. The migration was found to be best when the soil was at maximum water holding capacity than for lower values, for here the diffusion of the root extract from the thimble into the soil was somewhat of a problem. Gelatin suspensions of root extract considerably lessened the losses from the thimble but at lower soil moisture values the counts were even more variable.

Tomato root extract was found to be superior to cane-root extract as well as carrot, potato and grass root extracts. The fact that the species of nematodes infecting cane roots is known to be the type that will also invade tomato roots (i.e. *Meloidogyne species*) was a point in favour of the use of tomato roots, but why cane root should not be equally as acceptable is not clearly understood. The project has for the meantime been shelved for a later date.

DEGRADATION OF BUDS

During 1959 another form of microbiological research was undertaken. The project deals with the biological (bacterial and fungal) degradation of sugarcane buds subjected to hot water treatment at 50°C for two hours. The latter treatment is the standard therapeutic measure employed in this country in combating the virus ratoon stunting disease. In a normal commercial planting, many buds fail to germinate and this failure is considerably increased following the planting of hot-water-treated setts. Results to date indicate that bacterial decomposition of the bud tissues is probably one of the chief contributors to this failure.

The project was inaugurated with a view to finding a means of protecting buds from direct contact with the hot water on the assumption that the buds became softened and saturated by this contact. No evidence of water saturation of the bud material was in fact established, but softening action of the water was detectable. Various compounds of rubber and plastics have been employed in an attempt to allow heat penetration but minimise contact with the water. So far, there are indications that such protective measures do in fact work, but the cost, and amount of labour involved in handling quantities of cane in this manner are prohibitive.

The investigation is now being handled more from the biological deterioration viewpoint.

A list of possible microbiological projects was drawn up from which certain projects were designated as of immediate priority with the balance being assigned secondary importance. Space does not lend itself to a discussion of these projects and thus those of immediate priority, only, are listed below.

(a) Fertilizer studies, in particular the fate of nitrogenous fertilizers.

(b) Wetting and drying effect on soil with particular reference to nitrogen.

(c) Routine investigations for basic and particular differences between soil groups.

(d) Locality and annual differences in, and between, soil groups.

Cane Pests

Entomologist: J. DICK

Eelworm Investigations.

The main project of the entomological section has been a survey to determine the distribution and importance of eelworms in sugarcane fields. Particular attention has been paid to the red and grey Recent Sands since it has been in these soils that injury to cane has been noticed, but some fields on Table Mountain sandstone have been examined, as well as a few on other soil types. It was decided to start with the North Coast area and practically all estates on Recent Sands in this area have now been inspected.

Methods of Sampling.

Two or three stools of cane are dug up from each site. In older cane it has been found advisable to select stools with some actively growing shoots since these are associated with living roots. A sample of the roots is enclosed, with soil, in a polythene bag. At the same time a sample of soil is collected for analysis by the Fertilizer Advisory Service.

In the laboratory, the root samples are washed and sub-sampled. Approximately 30 gm. of root material is taken, including the most active roots available. The roots are cut into short lengths, mixed with about 90 ml. of water and shredded in an Atomix grinder for three minutes. Each sample is then poured into a beaker and allowed to stand for about 30 minutes. By means of a pipette, subsamples of about 0.4 ml. are taken from the bottom of the beaker and examined microscopically. Eggs, larvae and adults present are counted, four subsamples being examined for each sample.

Although this method is not strictly quantitative, it has been found sufficiently accurate for purposes of comparison.

Soil samples are planted with tomato seeds and, after four to six weeks, depending on temperature, the tomato roots are examined for nodules. However, variability in growth of the plants and secondary increase of eelworms in the roots raise doubts as to the quantitative value of this method. Funnel extracts of some soil samples have been made, by which free-living forms are isolated. It is not yet known, however, which of the species obtained are likely to attack cane roots.

Assessment of Infestation.

Though some injury may be caused to cane roots by the external feeding of free-living nematodes, the present survey has concentrated mainly on internal parasites which can be found within the roots themselves and which appear to be sufficiently important to justify independent investigation. The species most commonly encountered have been identified as *Meloidogyne javanica* Chitwood and *M. incognita* var. *acrita* Chitwood. A spiral parasite is also found, but in smaller numbers. On the basis of counts of eggs, larvae and adults of these species in root samples, a system of rating has been worked out which facilitates comparison between fields. Unfortunately, for practical reasons, adequate replication of samples has been impossible. This factor, together with possible fluctuations in population density, may have been a source of inaccuracy, but it would appear that certain fields are always above average and others below, as has been indicated by repeated sampling of a few such fields.

Samples from a total of 336 fields on 70 estates have been examined. Of these, none was found to be completely free of eelworms.

179	were	below average, rating	1
92	,,	average ,,	2
36	,,	above average ,,	3
22	,,	high ,,	4
5	,,	very high, ,,	5
2	,,	exceptionally high, ,,	6.

Figures from the survey to date have been examined in an attempt to discover correlations between eelworm populations and various factors in the environment such as pH, organic matter and clay content of the soil and the amount of plant nutrients present, cane variety, plant or ratoon crops and age of cane. The fact that no statistically valid correlations have been revealed may, in part, be due to the fact that the figures are derived from heterogeneous samples. It is expected that a correlation between population intensity and age of cane will be shown by repeated sampling of the same field.

Field Trials.

Two field trials, both on red sands in the Empangeni area, were harvested, one as a 19 month first ratoon, the other as a 27 month plant cane.

In the first experiment, the treatments applied before planting were : Copper sulphate at 100 lb. per acre, calcium hydroxide at 2 tons per acre, 4.5 per cent E.D.B. over the whole plot at 24 gallons or in the furrow alone at 6½ gallons per acre. The design was a 5 x 5 Latin Square. The results for plant cane and first ratoon crops are compared in Table 1.

TABLE 1.

Treatment	Tons Cane per acre		Tons sucrose per acre	
	Plant Cane	1st Ratoon	Plant Cane	1st Ratoon
Control	20.41	33.47	2.90	4.75
Copper sulphate	20.08	39.99	2.80	5.49
Calcium hydroxide	16.58	24.79	2.46	3.33
EDB Continuous	32.03	32.31	4.70	4.55
EDB Line	28.37	31.95	4.03	4.37
Least significant (5% :	4.34	6.90	0.65	0.86
difference (1% :	6.08	9.67	0.91	1.21

It will be noticed that the highly significant increase due to soil fumigation in the plant cane crop has not been maintained in the ratoons. The decrease in yield due to calcium hydroxide and the apparent increase in the ratoons following treatment with copper sulphate are probably independent of any effect which these materials might have on nematodes.

The second trial was laid down on a split plot design with four replications. Fumigation with EDB was carried out at three levels, in addition to controls, the material used being the more dilute 2.25 per cent solution. This was applied over the whole plot at 20, 40 or 60 gallons per acre. Half of each main plot was treated with Empangeni filter-cake at 40 tons per acre, applied in the furrow before planting.

The yields, as a 27 month plant-cane crop were as shown in Table II.

Analysis of these results, for both tons cane and tons sucrose per acre, indicated a significant linear response to EDB and a significant response to filter cake. The apparent curvature in response to EDB and the apparent interaction between EDB and filter-cake were not statistically significant. However, EDB at 40 gallons per acre would appear to have been the best fumigant treatment, giving an increase of 14 tons cane per acre. Treatment with filter-cake yielded an increase of 8 tons cane per acre. It is suggested that the possibility of interaction between the two treatments might justify further investigation.

A further three field trials were planted during the year. One, at Mposa, is designed to investigate possible differences in susceptibility

TABLE II.

Mean Tons Cane per Acre.

	Control	EDB 20	EDB 40	EDB 60	Mean
No filter cake	29.47	24.85	37.54	33.52	31.34
Filter Cake	27.26	36.64	47.45	44.76	39.03
Mean	28.36	30.74	42.50	39.14	35.18

Least Significant Differences between E.D.B. means : 11.76 at 5%, 16.90 at 1%
between Filter cake ,, : 6.88 ,, 5%, 9.65 ,, 1%

Mean Tons Sucrose per Acre

	Control	EDB 20	EDB 40	EDB 60	Mean
No filter cake	4.27	3.76	5.42	5.01	4.61
Filter Cake	3.87	5.31	6.93	6.34	5.61
Mean	4.07	4.53	6.17	5.68	5.11

Least Significant Differences between E.D.B. means : 1.63 at 5%, 2.35 at 1%
between Filter cake ,, : 0.91 ,, 5%, 1.28 ,, 1%

of eight released varieties of cane. Another, at Mtunzini, compares the effects of soil fumigation with four different chemicals, while the third, at Compensation, combines two different fumigants and two cane varieties.

A series of field trials planned for planting during the coming season is aimed at investigating the effect of fertilizer treatment on eelworm populations, the effect of organic materials including molasses and compost, soil treatment with calcium cyanamide, and the susceptibility of a number of new cane varieties.

Assessment of Soil Fumigation.

The only fumigant for which quantitative results are as yet available is EDB. Experiments have suggested that optimum results are obtained from applications of 40 gallons per acre of the 2.25 per cent solution. At this rate, the price of the fumigant alone would be £21 per acre, the cost of application being in the neighbourhood of £3 per acre. To compensate for this expenditure an increase of 16 tons cane per acre would be required, whereas experiments so far harvested have indicated an increase of between 12 and 14 tons. Only one experiment has been harvested as a ratoon crop, but this showed no residual effect of fumigation.

In soil which is known to be infested with eelworms, cane develops much more vigorously in fumigated than in untreated plots for the first few months after planting. After about eight months, however, the growth rate slows down and symptoms of injury begin to appear. The treated cane maintains, but does not increase, its lead. Examination of root samples from treated plots shows that fumigation has not caused complete mortality and that, after about eight months, populations of eelworms are becoming appreciable. Comparisons between treated and untreated plots are given in Table III, in which the figures represent averages of eight samples.

Table III

Regeneration of Eelworm Populations after Fumigation.

Site: Compensation, 6 months after treatment.			
Untreated :	8.1 eggs	55.2 larvae	0 adults
EDB, 40 galls.:	8.5 „	31.0 „	0 „
Site: La Lucia, 10 months after treatment.			
Untreated :	14.0 eggs	27.9 larvae	4.4 adults
EDB, 40 galls.:	10.0 „	19.0 „	0.0 „

A factor which militates against the profitable application of fumigants is the fact that harmful infestations tend to occur in poor, sandy soils. These may not be able to yield a crop sufficiently large to compensate for the cost of treatment. The possibility that more generous fertilizer applications may enable the cane to take advantage of the beneficial effects of fumigation is to be investigated in experiments combining fertilizer and fumigant treatments.

Soil fumigation against eelworms is apparently profitable in certain annual crops. However, the results so far obtained in sugarcane fields suggest that, at present prices, it is of greater value as an indicator of the presence of harmful infestations than as a practical means of control.

Fertilizers

Advisory Chemist: T. A. F. SEXTON

The total number of samples received from all sources during the year ended April 30th, 1960, shows a slight increase over those dealt with during the preceding year. It has been gratifying to note that more use is being made of the Fertilizer Advisory Service in that no less than 6,763 soil samples were sent in by farmers, together with 1,719 specimens of leaves. Whilst the number of soil samples has fallen considerably below the figure recorded for the previous year, this is accounted for by the fact that during the 1958/59 season, a considerable number were taken for growers by Station personnel, a practice which has since been discontinued. The increase in the number of leaves received for testing stems from a letter circularized to the Industry, suggesting that checks on the uptake of nutrients should be made.

Soils from the plots of Regional Fertilizer Trials have shown a marked decrease, due to the fact that a number of experiments in this scheme are now being discontinued. On the other hand, the number of leaf samples dealt with has shown an all time record at 5,547.

Samples of fertilizers, water, composts and natural manures have continued to come in, and during the 1959/60 season, amounted to a total of 335. In Table I, a record of all samples received since the Service was inaugurated will be found, details being given of the various types, the source from which they emanated and the purpose for which they were used.

TABLE 1.

Advisory Samples	1955-56	1956-57	1957-58	1958-59	1959-60	Grand Total
Soils	5,563	5,138	3,843	8,365	6,763	29,672
Leaves	2,420	3,133	1,241	1,555	1,719	10,068
Fertilizers and Miscellaneous	121	336	517	259	335	1,568
Total	8,104	8,607	5,601	10,179	8,817	41,308
Experimental Samples						
Soils from Regional Fertilizer Trials	0	895	1,020	810	565	3,290
Leaves from Regional Fertilizer Trials	0	1,767	5,246	4,343	5,547	16,903
General Experimental Soils	89	630	1,218	1,574	1,462	4,973
General Experimental Leaves	178	2,194	2,402	676	1,227	6,677
Total	267	5,486	9,886	7,403	8,801	31,843
Yearly Totals.	8,371	14,093	15,487	17,582	17,618	73,151

TRACE ELEMENTS

During the 1959/60 season, work on trace element determinations has continued, and as before, methods of assay have been centred upon leaf analysis. The elements which have received the closest attention are manganese, zinc and copper. The uptake of these elements in cane leaves grown in various soil types has been set out in the following table :

TABLE II

No.	Soil Type	Manganese in Leaves			Zinc in Leaves				Copper in Leaves				Means		
		%age Deficient 0-25 ppm	%age Threshold 26-36 ppm	%age Adequate 36 and above ppm	%age Deficient 10-15 ppm	%age Threshold 16-20 ppm	%age Adequate 21-25 ppm	%age High 25 and above ppm	%age Deficient 0-2 ppm	%age Threshold 3 ppm	%age 4 ppm	%age Adequate 5 and above ppm	Mn ppm	Zn ppm	Cu ppm
1	T.M.S. Ordinary.. ..	0·6%	4·5%	94·9%	43·7%	31·8%	14·8%	9·7%	0·6%	8·7%	24·3%	66·4%	102·4	17·7	5·9
2	T.M.S. Mist	—	1·0%	99·0%	21·0%	26·0%	18·0%	35·0%	—	2·0%	7·0%	91·0%	121·0	22·3	7·4
3	Alluvia	1·7%	5·2%	93·1%	10·5%	28·1%	29·8%	31·6%	3·5%	—	1·7%	94·8%	107·2	22·5	8·7
4	Middle Ecca	—	3·2%	96·8%	16·1%	48·4%	32·3%	3·2%	—	3·2%	7·9%	88·9%	84·3	19·2	6·4
5	Lower Ecca	—	—	100·0%	15·9%	34·9%	38·1%	11·1%	—	3·2%	7·9%	88·9%	92·6	19·8	7·7
6	Granite	2·3%	2·3%	95·4%	13·6%	36·4%	50·0%	50·0%	—	9·1%	2·3%	88·6%	78·0	21·7	7·4
7	Red Sand	—	3·8%	96·2%	14·3%	19·0%	19·0%	47·7%	—	2·6%	5·1%	92·3%	103·5	25·2	8·0
8	Grey Sand	8·3%	—	91·7%	18·2%	45·4%	27·3%	9·1%					92·2	19·6	
9	Tugela Schist	—	—	100·0%	—	33·3%	66·7%	—	44·4%	11·1%	11·2%	33·3%	127·9	21·0	4·4
10	Dwyka	6·4%	9·7%	83·9%	35·5%	32·2%	19·4%	12·9%	—	—	12·9%	87·1%	63·1	18·8	6·5
11	Dolerite	—	2·9%	97·1%	30·3%	51·5%	18·2%	—	—	—	11·4%	88·6%	94·4	17·9	7·2

In establishing deficiency, threshold and adequacy levels, cognizance has been taken of the work of H. Evans in an article appearing in Tropical Agriculture 1955 : 32 : 295-322.

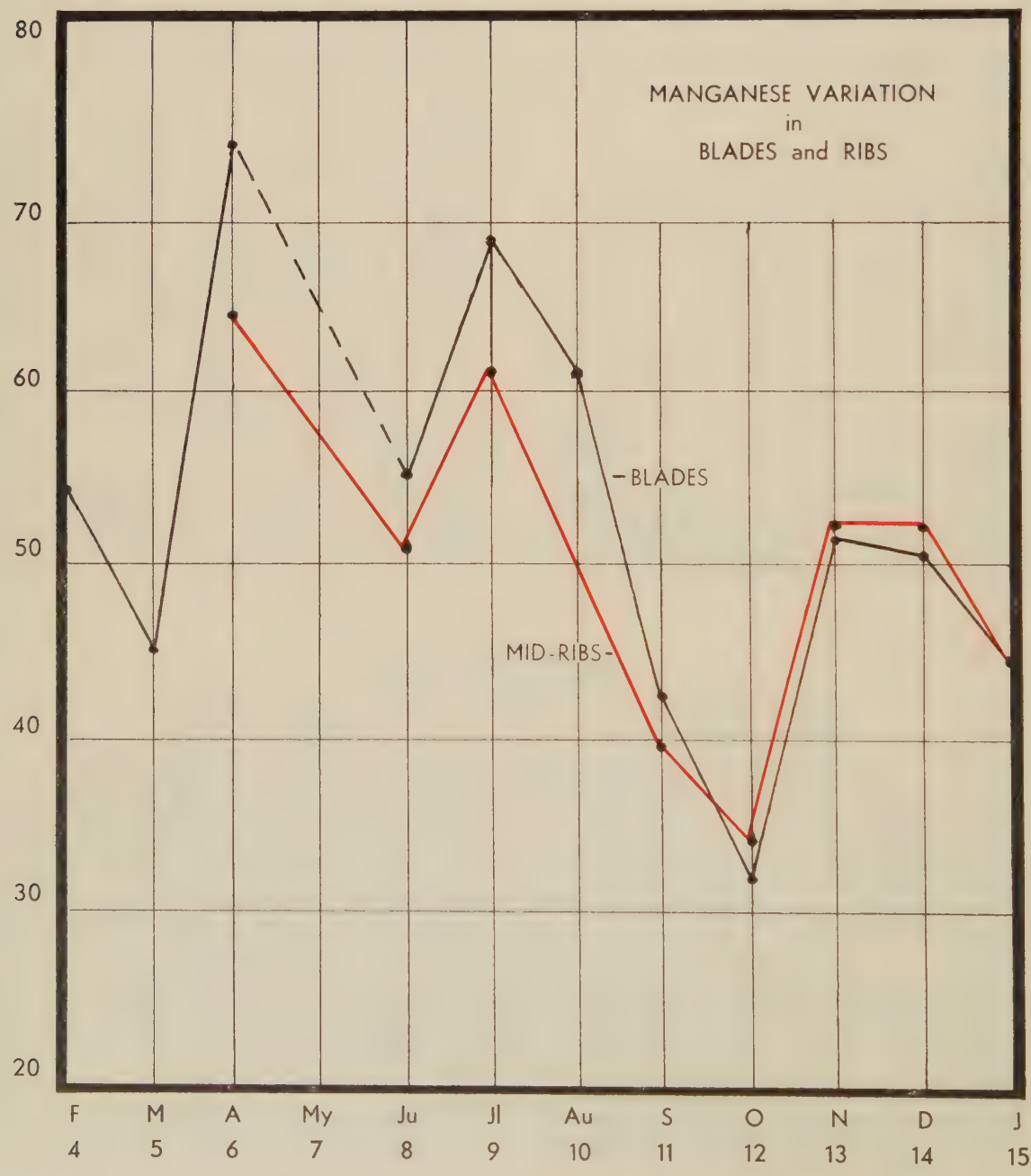
Evans concludes that manganese contents of about 24 ppm. (parts per million) constitute mild deficiencies, whilst levels of 40 ppm. in similar tissues are sufficient for the production of healthy leaves. For South African conditions, deficiency levels have been arbitrarily taken at 25 ppm., threshold values at between 26 and 35 ppm., and adequate quantities at 36 ppm. and upwards.

In the same publication, Evans considers that deficiencies of zinc are centred between 10 and 15 ppm., whilst levels in excess of 20 ppm. are satisfactory. With copper, 0.5 to 1 ppm. is considered to be deficient, whilst 3.5 ppm. is reasonable. The foregoing Table II has been set out in a manner closely associated with Evans's findings.

Manganese.

It was found that deficiency and threshold levels of manganese occurred mainly in the Dwykas and grey sands. It is noteworthy that

FIGURE I



the highest average uptakes were found in Tugela schists and T.M.S. mist belts whilst the lowest means arise with Dwykas and granites.

Zinc.

Referring to zinc, deficiencies were headed by T.M.S. ordinary and Dwykas, whilst with dolerites and Middle Eccas the greatest preponderance of threshold values arose. The maximum mean uptakes resulted from the red sands and alluvia, whilst the minimum averages occurred with T.M.S. ordinary and dolerites.

Copper.

The assimilation of copper was found to be deficient in leaves taken from cane grown in certain schists and alluvia. A proportion of leaves taken from schists, granites and T.M.S. ordinaries were moreover, found to be within the "threshold" range. With regard to the highest and lowest average figures relating to the uptake of copper, the maximum mean values were obtained with alluvia and sands, whilst the lowest occurred with T.M.S. ordinary and schist soils.

It will be appreciated that there are a large number of fields in the Industry which have more than one soil type. In extracting the foregoing data, only areas were used in which one soil type predominated.

Further work on Manganese.

The assimilation of manganese has been given rather special attention so far as its uptake by leaves is concerned. The analysis of numerous samples taken at regular intervals from the Experimental Farm at Chaka's Kraal has been made. It appears that the uptake of manganese is associated to some extent with the weather conditions, building up somewhat during the drier months and then falling to very low levels in October. This point is mentioned because, whilst leaf analysis presents a tempting diagnostic procedure for the elucidation of trace element problems, the figures obtained must be considered in the light of prevailing moisture relationships.

Figure I indicates the variations which occur in both the leaf laminae and mid ribs of the 3rd, 4th and 5th leaves. Generally, rather more manganese is found in the blades than in the midribs.

Zinc and Copper.

A limited amount of data concerning the uptake of zinc and copper in the same samples which were used in the foregoing manganese diagram, is also available. The figures obtained are set out in Table III.

It appears that whilst there is a tendency for zinc and copper to build up during the drier months, there is a slow falling off during the ensuing active growth period.

TABLE III.

MANGANESE, ZINC AND COPPER

(in the 3rd, 4th and 5th Leaves)

Age	Manganese ppm	Zinc ppm	Copper ppm
4	54	18	5.3
8	55	23	9.3
12	32	17	6.0
14	51	13	5.3
15	45	11	5.0

WORK ON SOILS.

From time to time soil samples of a brakish nature have been received from so-called "problem areas". The occurrence of sodium in soils has therefore been investigated, tests being made wherever possible. Figures have been classified into various ranges and are set out in the following table.

TABLE IV.

SODIUM IN SOILS.

	Range Sodium ppm	Number in Range	% age of Total
	1-10	34	5.8
	11-20	76	13.0
	21-30	162	27.7
	31-40	142	24.3
	41-50	87	14.9
	51-100	40	6.9
	100-200	29	5.0
*	200-500	14	2.4

* These soils would be associated with brakish conditions.

The number which contained sodium closely associated with brak, amounts to about 2.4% of all the soils so far examined for sodium. The rapid method provided by the Eel Flame Photometer for sodium determinations, was used in compiling this data.

Review of Weather Conditions

1st JUNE, 1959 to 31st MAY, 1960.

RAINFALL.

The average rainfall for 54 recording stations throughout the sugar belt was 35.66 inches for the year ending 31st May, 1960, which was somewhat below the mean annual rainfall of 37.93 inches, but higher than that of the previous year when the average rainfall was only 33.34 inches. The Industry has, therefore, gone through two successive years of rainfall below normal and although these adverse conditions were not extreme they had a depressing effect on crop yields.

Normal spring rains relieved the winter drought but the crop received a setback during January when it was dry. Good rains from February to April were followed by a rather dry May, but the condition of the crop at the end of May was still fair.

The average monthly rainfall from these recording stations and the monthly evaporation from an open water surface at the Experiment Station were as follows :

	Mean rainfall in inches 1924-1959	Actual rainfall in inches June 1959-May 1960	Mean evaporation in inches 1936-1959	Actual evaporation in inches June 1959-May 1960
June	1.45	0.07	2.35	2.34
July	1.07	0.66	2.52	2.51
August	1.40	2.35	2.93	3.33
September	2.59	2.63	3.61	4.06
October	3.54	4.58	4.16	4.74
November	4.23	3.03	4.73	4.62
December	4.70	3.99	5.31	5.40
January	4.15	2.10	5.63	5.46
February	4.76	5.05	4.72	4.87
March	5.26	4.68	4.43	5.21
April	2.66	5.12	3.35	3.35
May	2.12	1.40	2.80	2.74
Annual	37.93	35.66	46.54	48.63

With the annual rainfall below normal and evaporation above normal there were only a few months when the cane crop would not have benefited from irrigation or a higher rainfall.

TEMPERATURES AND SUNSHINE.

The mean screen temperature at the Experiment Station was 68.7°F for the year or 0.1 below normal. The winter months, June to August, were warm and particularly so July which had a mean temperature 2.2°F above normal. The mean temperatures for all other months with the exception of March and October were however low and April had a mean screen temperature of only 68.0°F or 2.3° below the normal for that month.

The hours of sunshine during the year were 101.0 per cent of normal. The fact that the hours of sunshine for the period March to June were slightly above normal gives rise to the hope that sucrose per cent cane for the coming season will be at least normal.

SUMMARY AND CONCLUSIONS.

For the second year in succession the rainfall has been below normal. Temperatures were also low during some of the important growing months for the past year. Deficient rainfall and low temperatures are likely to cause a considerable fall in yield of cane per acre. Sunshine conditions were, however, such that at least an average sucrose per cent cane can be expected for the coming year.

Appendix 1

Exchange of varieties and the early stages of seedling raising and selection.

VARIETIES INTRODUCED.

During the 1959-60 year, the following varieties were introduced into Natal from other countries :

Pakistan : Co.'s 677, 681, 709, 720, 744, 793, 810, 858, 873 and 979.

Kenya : Co.S. 443, Co.S. 510, B.O. 14, and Co.'s 718, 740, 746, 765, 798, 911 and 1001.

Queensland : Q.67, Q.68, Q.70, L.76 and M.98.

Mauritius : M.311/41, M.129/43 and 51 N.G.142.

Taiwan : F.'s 135, 136, 137, 138, 139, 140 and 143.

Cuba : J.'s 55/485, 55/487, 55/488, 55/663, 56/40/14/31, 56/43/21/5, 56/43/24/1, 56/43/24/15, 59/3/10/1, 59/3/21/2, 59/3/50/5, 59/3/60/9, and 59/4/84/13, P.B.51/1/1, P.B.51/1/4, Naz.716 and a presumed apogamous seedling of N:Co.310.

VARIETIES EXPORTED.

The following varieties were sent in exchange to other countries :

Queensland : N.10 and N.50/211.

Sudan : B.42231, B.4362, Co.421, Co.617, C.P.44/101, C.P.51/27, M.147/44, N:Co.310, N:Co.376, P.O.J.2878, Q.50 and Trojan.

S. Rhodesia : B.H.10/12, Co.432 and Co.453.

Kenya : B.4744, B.O.11, Co.440, M.134/32 and P.R.809.

Spain : N:Co.'s 292, 293, 334, 339, 376, 382 and N.50/211.

Ethiopia : B.O.10, B.O.11, Co.644, C.P.44/155 and C.P.48/103.

Japan : N:Co.334 and N:Co.376.

SEEDLINGS RAISED IN 1959.

Parentage	No. of female tassels	No. of seedlings	
		Germinated (Estimated)	Planted in field
From seed produced in 1955.			
Co.281 selfed	3	55	39
Co.301 selfed	1	90	74
Co.331 selfed	2	45	38
From seed produced in 1957.			
Co.205 x Co.331	2	500	366
Co.312 x N:Co.382	1	130	118
Co.331 x U.S.1694	2	60	51
Co.421 x B.O.3	1	19	17
Co.421 x Hind's Special	2	650	584
Co.421 x N.51/1009	2	12	11
C.P.27/108 x N.51/1009	2	32	31
C.P.27/108 x N:Co.382	2	430	398
G.256 x Co.331	1	120	97
N.10 x U.S.1694	2	80	74
N:Co.292 x Co.285	2	18	15
N:Co.293 x G.256	2	34	33
N:Co.376 x N.121	2	26	25
N:Co.376 x N.51/1009	2	10	8
N:Co.376 x U.S.1694	2	550	494
N:Co.382 x U.S.1694	1	230	194
N:Co.390 x N.51/1009	1	11	11
P.O.J.2725 x N:Co.382	2	130	114
From seed produced in 1958.			
Co.205 x N:Co.293	1	620	580
Co.281 x Co.301	2	55	51
Co.301 x C.P.36/211	2	38	32
Co.301 x N.51/1069	1	9	9
Co.301 x N.56/1312	1	470	442
Co.301 x N.56/1322	1	20	20
Co.301 x 51 N.G.70	1	12	11
Co.301 x 51 N.G.91A	1	2	1
Co.301 x N:Co.293	2	200	189
Co.312 x N:Co.382	1	3	3
Co.331 x Co.285	3	650	612
Co.331 open cross	8	30	25
Co.356 x Co.331	1	420	381
Co.419 x Co.331	1	64	60
Co.421 x Co.301	2	740	694
Co.421 x Co.312	12	6,250	5,849
Co.421 x Co.317	2	80	72
Co.421 x Co.331	6	1,200	1,013
Co.421 x C.P.29/116	2	45	38
Co.421 x G.255	4	1,570	765
Co.421 x N.Co.293	2	200	176
Co.421 x N:Co.376	2	90	77
Co.421 x N.M.37	2	26	26
Co.453 x N:Co.293	1	575	523
Co.453 x N:Co.382	2	55	49
Co.453 x Uba Marot	2	6	6
C.P.27/108 x Co.331	2	2,100	1,763
C.P.34/139 x Co.285	2	2	2
C.P.34/139 x Co.312	2	320	295
C.P.34/139 x N:Co.382	2	700	650
C.P.36/ 85 x N:Co.382	1	2,100	393
C.P.36/191 x Co.331	2	700	535
Diamond 10 x Co.301	1	1	0
5E x Co.285	1	245	220
F.108 x N:Co.382	1	2	2
H.M.619 x Co.301	1	2	2
N.10 x Co.285	1	275	259

Parentage	No. of female tassels	No. of seedlings	
		Germinated (Estimated)	Planted in field
N.10 x N:Co.376	1	3	2
N.10 x N:Co.382	2	8	6
N.50/123 x Co.285	1	63	62
N.50/123 x Co.331	2	30	24
N.50/211 x N:Co.382	2	4	3
N.51/783 x Co.331	1	1	1
N.52/408 x Co.331	1	160	144
N.53/ 31 x Co.331	1	1	1
N.53/193 x Co.331	1	60	55
N.56/1317 open cross	1	6	6
N.56/1318 x Co.331	2	4	3
N:Co. 79 x N:Co.382	2	170	155
N:Co.291 x Co.285	1	15	14
N:Co.291 x Co.331	2	330	294
N:Co.291 x Co.527	2	270	242
N:Co.291 x N:Co.293	2	5	3
N:Co.291 x N:Co.382	2	15	15
N:Co.291 x N:Co.390	2	20	18
N:Co.291 x Uba Marot	1	3	1
N:Co.292 x Co.301	1	980	676
N:Co.292 x Co.312	1	220	197
N:Co.292 x Co.331	2	1,850	1,653
N:Co.292 x N:Co.382	1	775	720
N:Co.293 x Co.285	1	65	60
N:Co.293 x Co.301	4	1,750	1,586
N:Co.293 x Co.317	2	32	30
N:Co.293 x Co.331	8	1,320	1,215
N:Co.293 x Co.527	1	125	118
N:Co.293 x C.P.29/116	2	27	27
N:Co.293 x C.P.36/211	2	16	15
N:Co.293 x N.51/1069	2	275	261
N:Co.293 x N.56/1312	1	140	129
N:Co.293 x N.56/1322	1	20	16
N:Co.293 x 51 N.G.70	1	12	12
N:Co.293 x Uba Marot	2	55	51
N:Co.310 x Co.331	3	328	310
N:Co.310 x 51 N.G. 91A	1	3	2
N:Co.310 x N.M.37	2	2	1
N:Co.310 x N.M.222	1	60	57
N:Co.339 x Co.317	2	45	40
N:Co.339 x Co.331	2	2,200	1,710
N:Co.339 x N:Co.293	2	675	625
N:Co.339 x N:Co.382	1	13	13
N:Co.339 x N.M.37	1	250	221
N:Co.349 x Co.285	1	29	27
N:Co.349 x Co.312	1	170	150
N:Co.349 x Co.331	2	48	45
N:Co.349 x Co.527	1	4	4
N:Co.349 x N:Co.376	1	24	22
N:Co.349 x N:Co.382	2	7	7
N:Co.349 x N:Co.390	2	3	2
N:Co.376 x Co.205	2	685	658
N:Co.376 x Co.301	3	900	847
N:Co.376 x Co.331	2	180	171
N:Co.376 x Co.527	2	375	334
N:Co.376 x C.P.29/116	2	15	14
N:Co.376 x G.256	2	9	8
N:Co.376 x N.51/1069	2	200	184
N:Co.376 x N.56/1312	2	680	641
N:Co.376 x N.56/1322	1	200	191
N:Co.376 x 51 N.G. 91A	2	1	1
N:Co.376 open cross	6	2,300	2,041
N:Co.376 x Uba Marot	5	1,760	1,630
N:Co.382 x Co.331	1	550	514
N:Co.382 x Uba Marot	1	4	4
N:Co.390 x Co.285	1	36	36
N:Co.390 x G.255	2	3	3
N:Co.390 x N:Co.293	1	8	4
N.M.37 x N:Co.382	1	20	11
N.M.37 x N:Co.390	1	22	20
N.M.222 x Co.331	1	625	523
N.M.222 x N:Co.293	1	845	756
N.M.222 x Uba Marot	1	11	11
P.O.J.2725 x Co.285	1	240	223
P.O.J.2725 x Co.331	1	85	82
P.O.J.2725 x N:Co.382	1	6	5
P.O.J.2803 x Co.205	1	575	534
Uba x Co.331	4	15	15
Uba x N:Co.376	1	45	41
Uba Marot open cross	8	170	153
Total	263	46,365	39,323

Selections from bunches planted as bunch stools in 1959.

Parentage.	No. Planted.
Co.301 x Co.285	29
Co.301 x Co.356	2
Co.301 x G. 255	22
Co.312 x Co.356	6
Co.312 open cross	25
Co.455 x Co.301	23
C.P.29/116 x Co.301	6
C.P.34/120 x G.255	4
C.P.34/120 open cross	17
C.P.36/111 open cross	30
N.54/551 open cross	12
N:Co.79 x G.255	13
N:Co.339 x C.P.36/85	9
N:Co.339 x *S. robustum* seedling	12
Total from 14 crosses	210

Seedlings planted as micro-lines (on environment stations) in 1959.

Parentage.	No. Planted.
C.B.38/22 x Co.331	89
Co.301 x Co.331	59
Co.331 x Co.205	30
Co.331 x Co.285	61
Co.331 x Co.301	31
Co.421 x C.B.38/22	51
Co.421 x Co.285	47
Co.421 x Co.301	62
Co.421 x Co.312	20
Co.421 x Co.313	10
Co.421 x Co. 331	58
Co.421 x N.M.222	33
Co.421 x U.S.1694	4
Co. L. 9 x Co.285	13
C.P.36/13 x Co.285	5
C.P.36/85 x Co.331	56
C.P.44/101 x Co.331	81
C.P.44/101 x N:Co.382	54
N:Co.154 x Co.301	18
N:Co.292 x Co.331	97
N:Co.293 x Co.331	77
N:Co.310 x Co.301	227
N:Co.310 x Co.331	244
N:Co.339 x Co.301	36
N:Co.339 x Co.331	87
N:Co.339 x C.P.36/85	24
N:Co.339 x *S. robustum* seedling	15
N:Co.349 x Co.205	23
N:Co.349 x Co. 285	291
N:Co.349 x Co.301	16
N:Co.349 x N:Co.293	72
N:Co.376 x Co.285	107
N:Co.376 x N:Co.293	14
N:Co.376 x N.M.37	36
N:Co.376 x N.M.222	36
Total 35 crosses	2,184

N.59 Single Lines under irrigation — Planted Sept. 1959.

Parentage.	No. Planted.
C.B. 38/22 x Co.331	23
Co.421 x Co.301	15
Co.421 x Co.331	36
C.P.44/101 x Co.331	20
C.P.44/101 x N.M.222	19
N:Co.310 x Co.301	12
N:Co.339 x Co.301	23
N:Co.339 x Co.331	30
N:Co.349 x N:Co.293	16
Total from 9 crosses	194

N.60 Single Lines Planted March 1960.

Parentage.	No. Planted.
C.B.38/39 x Co.331	31
Co.205 x G.255	6
Co.214 x Co.331	11
Co.243 open cross	11
Co.281 x Co.331	40
Co.281 x G.255	6
Co.281 x N.M.37	1
Co.285 x Co.331	4
Co.285 x N:Co.382	5
Co.301 x Co.285	17
Co.301 x Co.356	4
Co.301 x G.255	7
Co.301 x N:Co.293	1
Co.312 x Co.331	17
Co.312 x Co.356	4
Co.312 open cross	17
Co.331 x C.P.36/85	11
Co.331 x G.255	21

Parentage.	No. Planted.
Co.331 x N:Co.382	6
Co.421 x Co.331	80
Co.421 x Co.419	12
Co.421 x Co.527	19
Co.421 x C.P.34/139	7
Co.421 x C.P.36/105	9
Co.421 x 6 E	2
Co.421 x N:Co.382	3
Co.421 x N:Co.390	3
Co.453 x Co.419	5
Co.453 x G.255	12
Co.453 open cross	19
Co.455 x Co.301	14
Co. 527 x Co.301	2
Co.527 x Co.331	18
Co.617 x Co.331	28
Co. L 9 x Co.285	11
C.P.27/108 x Co.301	4
C.P.29/116 x Co.285	11
C.P.29/116 x Co.301	23
C.P.29/116 x Co.331	6
C.P.34/120 x Co.301	6
C.P.34/120 x G.255	4
C.P.34/120 open cross	10
C.P.34/139 x G.255	6
C.P.36/85 x Co.285	1
C.P.36/85 open cross	11
C.P.36/105 x Co.331	6
C.P.36/111 x Co.301	17
C.P.36/111 open cross	15
C.P.36/211 x Co. 331	19
C.P.38/34 x Co.331	41
C.P.44/101 x N:Co.382	13
C.P.44/101 x N.M.222	23
C.P.51/27 x Co.331	19
F.108 x G.255	1
F.108 x N.M.222	12
N.10 x Co.285	20
N.10 x Co.301	3
N.10 x Co.331	17
N.10 x N:Co.382	3
N.50/59 x Co.331	19
N.50/123 x Co.331	9
N.50/211 x N:Co.382	4
N.52/214 x Co.301	4
N.52/214 x Co.331	11
N.52/411 x Co.301	2
N.53/249 x Co.331	5
N.54/142 open cross	13
N.54/143 open cross	6
N.54/549 x N:Co.293	8
N.54/550 x Co.331	2
N.54/551 open cross	24
N:Co.79 x C.P.36/85	1
N:Co.79 x G.255	1
N:Co.79 x N:Co.293	3
N:Co.79 x N:Co.339	1
N:Co.79 x *S. robustum* seedling	1
N:Co.154 x N.M.222	4
N:Co.291 x Co.301	10
N:Co.291 x N:Co.293	54
N:Co.292 x C.B. 38/22	8
N:Co.292 x N:Co.293	14
N:Co.292 x N.M.222	9
N:Co.293 x Co.301	14
N:Co.293 x 6E	2
N:Co.293 x G.255	22
N:Co.293 x N:Co.382	2
N:Co.293 x N:Co.390	5
N:Co.293 x N.M.37	2
N:Co.310 x Co.205	30
N:Co.310 x Co.527	1
N:Co.310 x C.P.34/139	1
N:Co.310 x C.P.36/85	1
N:Co.310 x N.M.37	8
N:Co.310 x N.M.222	3
N:Co.339 x Co.455	4
N:Co.349 x *S. robustum* seedling	17
N.Co.376 x Co.331	17
N:Co.376 x Co.419	1
N:Co.376 x N:Co.382	13
N:Co.382 x Co.285	11
N:Co.382 x Co.331	1
N:Co.382 x N.M.37	9
N:Co.382 x N.M.222	22
N:Co.390 x Co.301	12
N.M.222 x N:Co.293	1
P.O.J. 100 x *S. spontaneum* Kloet	1
P.O.J.2725 x Co.285	3
P.O.J.2725 x N.M.222	1
Q.49 x N:Co.293	4
Total from 109 crosses	1,176

Appendix 2

PUBLICATIONS OF THE EXPERIMENT STATION 1959-60

BULLETINS

No. 11. Liming in the sugar industry.

BOOKS, PAPERS, REPORTS, ETC.

Soils.

Beater, B. E. Soil survey as a factor in the development of the S.A. Sugar Industry. Proc. Int. Soc. Sugarcane Tech. 1960.

The two-handled Mount Edgecombe Soil Sampler — Ibid.

Maud, R. R. The compaction of sugar belt soils at various moisture levels. Proc. S.A.S.T.A. 1960.

Chemistry.

du Toit, J. L. Recent advances in nutrition of sugarcane in South Africa. Proc. Int. Soc. Sugarcane Tech. 1960.

" Plant nutrition, fertilizers etc. Report of the S.A. delegates to the 10th Congress of the I.S.S.C.T. 1960.

Agriculture.

Pearson, C. H. O. The conception of farming on sub-tropical soils, with the use of the crop by-product, trash, as a means to improve yields. Proc. Int. Soc. Sugarcane Tech. 1960.

" Agronomy. Report of the S.A. delegates to the 10th Congress of I.S.S.C.T. 1960.

Wilson, J. The controversial and important subject of trashing. S.A. Sugar Journal 44. 4. 1960.

Cane breeding.

Brett, P. G. C. Variety and environment. Proc. S.A.S.T.A. 1960.

General.

du Toit, J. L. Some items of economic importance in sugar production. Proc. S.A.S.T.A. 1960.

Wilson, J. The pre-release testing of new varieties and the control of sugarcane diseases. S.A. Sugar Journal 44. 3. 1960.

" The quota problem. S.A. Sugar Journal, 44. 5. 1960.

EXPERIMENT STATION BULLETINS

No. 1.	1956.	Gumming disease in Natal.
No. 2.	1957.	Fertilizer responses.
No. 3.	1957.	Comparative yielding ability and disease resistance of South African cane varieties.
No. 4.	1957.	The identification of the more important sugarcane varieties grown in South Africa.
No. 5.	1957.	The growth and development of the sugarcane plant.
No. 6.	1958.	Sucrose formation and concentration in sugarcane.
No. 7.	1958.	The production of new sugarcane varieties for Natal.
No. 8.	1958.	Sugarcane pests in South Africa.
No. 9.	1958.	Diseases of sugarcane in Natal.
No. 10.	1959.	The development of sugarcane breeding in South Africa.
No. 11.	1960.	Liming in the sugar industry.